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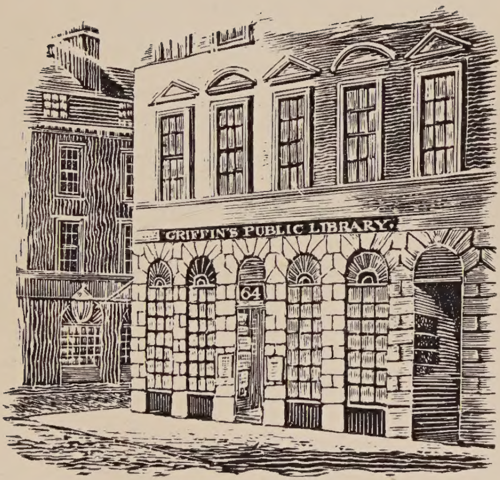

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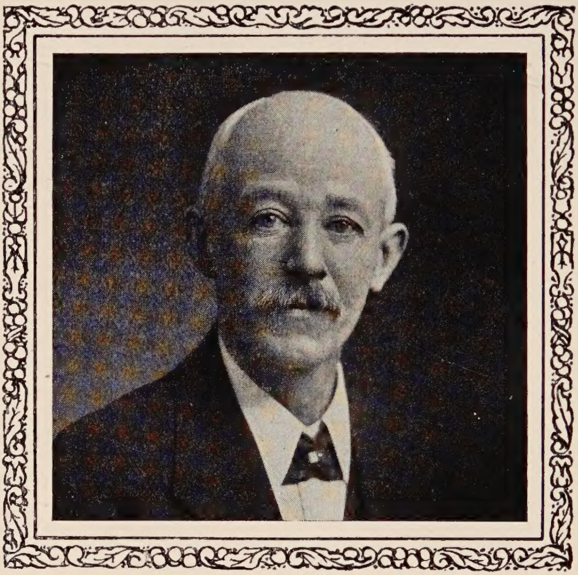

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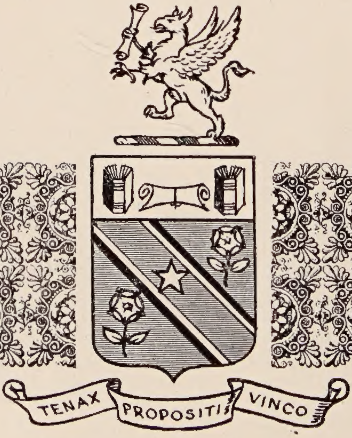
Chairman and Managing Director of Charles Griffin & Co., Ltd., Fellow of the Royal Society of Arts, Member of the Iron and Steel Institute, Member of the Faraday Society, Member of the Devonshire Association for the Advancement of Science, Literature and Art.



The CENTENARY VOLUME
of Charles Griffin and Company Ltd

PUBLISHERS
1820 1920

With Foreword by
Lord Moulton, P.C., G.B.E., K.C.B., F.R.S.

With Portraits and Other Illustrations

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QUIS SEPARABIT NOS?
1820

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"A seedling gem,
Worthy such noble stem."

[*See page* 20.]

FOREWORD

BY

The Rt. Hon. LORD MOULTON,

K.C.B., G.B.E., F.R.S.

OUR country is beginning to realise that in order to maintain its high place among the nations it must give itself no rest in the acquisition of new industries and in the further development of old ones. But in thus aiming at a great future one is too apt to forget the steps by which in the past it attained that position which it feels that it must now keep. In dwelling on the necessities of the present and the aspirations of the future we too readily forget what has been so worthily done in the past.

The realisation of the value of coal for motive power and mechanical transport, as well as for a heating agent, revolutionised the technology of the world, and Great Britain was the first country to take full economical advantage of the change. Its comparatively small size and the central position of its coalfields made it possible for its industries to grow up in close proximity to the newly developed source of heat and power, and thus in wellnigh all the then existing industries the new era commenced very early. If the practical enterprise of the British race had been accompanied with a corresponding thirst for the theoretical knowledge which can only be attained by study and experiment the speed with which we advanced to the foremost place in the world of production would have been maintained and we should not now be viewing with regret the many departments of industry in which we are obliged to recognise that our competitors have outrun us.

Unfortunately the same qualities that enabled us to start so quickly and advance so far have in recent years told against our progress. It was the sturdy self-reliance of the early manufacturers and their thorough knowledge of the practical side of their work which made them so successful in attaining pre-eminence and securing the control of the markets both in their own country and abroad, but this success made them too confident and led them to believe that the qualities which had raised them to that position were all that was necessary to maintain them in it in the future. Self-reliance developed into self-sufficiency, and the men who had attained success by their knowledge of the practical side of their industry assumed that this was all that was necessary or useful. They did not realise how their competitors in other nations—starting from the level of our own best achievements which they were careful to study and imitate—were devoting themselves to working out further advances by the aid of the Laboratory and the scientific institutions with which their Universities were so richly provided, thus letting abstract study and research develop new methods and deeper knowledge with which they would later on endow the world of practical work.

It is during the century covered by the above retrospect that the great publishing firm whose centenary this volume commemorates rendered its invaluable services to our country. Founded as a publishing firm in 1820, it soon made its special business to produce technological works of all kinds as well as scientific treatises of great value mainly associated with industrial problems. This was precisely that which our industrial world most needed. They brought within the reach of all who were willing to learn the scientific developments that were being made here and elsewhere in each particular industry, and thus they did all that it is in the power of books to do to break down the barrier which has long existed between the curiously insulated mind of the practical British manufacturer and his staff on the one hand, and the rapidly increasing stores of scientific knowledge that exist around us on the other. It is not possible for me or perhaps for anyone rightly to gauge how great an influence for good this has been during the years that have passed away, but that the work of this firm may claim the credit of raising our technology in all the branches which it has touched will not be denied. The details of its doings will be found in the pages that follow, duly set out by men fully qualified to estimate the value of the works produced, and they show how courageously and indefatigably the firm has laboured to bring up our industrial methods to the best modern practice.

Let me here say a word on the importance of having good technological books in our own language. I fully appreciate the almost desolating completeness of the scientific works which Germany pours out so freely. Everything that has ever been discovered in any particular subject finds a place in their pages whether or not it merits the quasi-immortality which it thereby acquires. But the primary object of a book on technology is not reference but assimilation. It is addressed to those to whom the particular industry constitutes their daily life and that which it contains should become part of their mental store, ever present to them and influencing their actions, whether its effect be to stimulate them to change or to hold by their existing methods. In the case of my countrymen such an educational influence will never be obtained by books written in a foreign language. Taken as a whole they are not facile linguists, though I rejoice to see how the numbers are increasing of those who have a good working acquaintance with important foreign tongues and who find no difficulty in making use of foreign books of reference. But for the purpose of practical education and everyday use a technological book must be in English if it is to have its full effect upon our industries.

The Firm has had a varied and most interesting history. Its reputation and success has been due to the good fortune which has given to it in unbroken succession an able and enterprising head. During one of its most brilliant periods that position was occupied by a woman who showed herself in all respects worthy of her selection. She was followed in office by the present head, Mr. Francis James Blight, who has had the management of the business for the last twenty-five years, and to whom the exceptional prosperity of the Firm and its services to the country during the late war must be primarily ascribed. With my congratulations on past achievements I feel I must add my strong conviction that the work that is before him is heavier and more responsible than at any previous time. A rapid and sustained advance in our Technology can alone save us from ultimate national disaster. With our huge populations and their growing demands for food and increasing supplies of the necessary raw materials for our industries there is no prospect of our being able to bear the burdens of the future unless by advances in Technology we are able to produce better and more cheaply than our competitors. The nations from whom we must get our necessary supplies will in the long run judge our products impartially, and they will take them at their just value, and not otherwise. It is for us to see that they merit being valued highly, and this cannot be attained unless we raise to its proper standard the Technology of all our industries. To enable us to do this we must look to the spread of that knowledge which has been the chief care of the firm of Charles Griffin & Co.

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Chapter I.

MAKERS OF MODERN TECHNOLOGY.

By L. P. SIDNEY, M.B.E., Assistant Secretary of the Iron and Steel Institute; for some years Literary and Technical Reader to Charles Griffin & Co., Ltd.

"No. 12" Exeter Street, Strand—The Business of Publishing—Proof Reading and Corrections—How Books are Made—How Authors are Made — Makers of Modern Technology — Francis James Blight, F.R.S.E.—An Ancestry of Booksellers—His Early Career —His Association with Griffin's — Elizabeth Eaves Griffin — Richard T. Griffin—Charles J. Griffin—Hy. Brougham Griffin—Helen F. Griffin—Charles R. Griffin—Horace V. Blight, A.C.A. —Arthur Downer—A Succeeding Generation—Children of Charles R. Griffin and Horace V. Blight—The Staff—Griffin's and the Technical Press—Griffin's Tree and its Fruit—Conclusion.

Chapter I.

MAKERS OF MODERN TECHNOLOGY.

"No. 12 Exeter Street, Strand."

THE Strand; Fleet Street—the Fleet Street of Boswell and of Goldsmith, of Samuel Richardson, and of the cryptic Sir Philip Francis—and their environment have, for centuries past, been the hub of the Newspaper and Book World. There *are* publishing Houses east and west of this area, just as there are Society Dames north and south of Belgravia, but Covent Garden and Grosvenor Square have this much in common: they are the recognised centres of their respective worlds.

Exeter Street lies in *media res;* between Covent Garden and the Strand, and just behind the site of old Exeter Hall, and of older Exeter Change, famous for missionary meetings, and elephants * respectively. Next door but one from the corner of Burleigh Street, Strand, stands a tallish and somewhat grim building. That is "Griffin's." Its best friends (and it has many) might fail to enthuse over its architectural beauties; its worst enemies (if it has any) would hardly call it ugly, for it has the beauty of adaptation to the purpose for which it exists; an utilitarian fitness which redeems it from the commonplace.

---

* In the early days of the nineteenth century there was a collection of wild animals on exhibition at Old Exeter Change, known as the "Royal Menagerie." In 1862 great excitement was caused by one of the elephants who went mad and had to be shot after several unsuccessful efforts to induce him to swallow poison.

In the days when I knew it, it shared, on week-day afternoons and on Sundays and Holy days, the grimness of the whole street, but on "market mornings" it blossomed out. Then the window sills were adorned with flowers; its very doorstep was a mass of foliage over which the early-comer needed to tread warily, and the street itself a blaze of colour. On "market mornings" Exeter Street was packed with coster barrows and patient donkeys, which Suburbia would presently acclaim, for Covent Garden overflowed its boundaries and the drab streets adjoining revelled in an unaccustomed "colour scheme," and wore an appearance of unwonted gaiety and bustle. Now, alas! that custom has vanished: Exeter Street preserves its own local colour and austerity week in and week out.

Open the door of No. 12. The impression of drabness disappears, and only a sense of that all-pervading utilitarian adaptation remains. The place is clean, very clean, and cheerful. It is roomy; it is friendly, and it smells of books. It has an air of quiet but not of stagnation. Indeed it is busy, in a studious and dignified way; that is to say, there is much a-doing but no flurry. An air of discipline and orderly activity prevails. Now, a business house, like a private dwelling, derives its tone from the management. We are at once impressed with a sense that "Griffin's" is well and efficiently managed. Later, we shall see that this is inevitable; the Managing Director of Charles Griffin & Co., Ltd., is what the atmosphere of the firm proclaims him—efficient. It will be my very great privilege to introduce him to you anon; a privilege not necessarily discounted by the fact that you too, reader, know him. It is always pleasant to renew old acquaintances.

The Business of Publishing.

Before turning to this part of my subject, however, I would like to deal briefly with the business of publishing. In the minds of a certain section of the public, the publisher is an irresponsible and somewhat voracious plutocrat who, having secured his author, lures him into his capitalistic web, and thereupon exploits him first and devours him afterwards; whose risk is insignificant and whose profits are outrageous, and who is neither more nor less than our old friend Shylock, scantily disguised. This view is a long way—a very long way—from the truth. The risk is very often out of all proportion to the prospective profit, and nowhere is this more so than in publishing the kind of technical books which is Messrs. Charles Griffin & Co.'s speciality.

Few people, and authors frequently least of all, have any conception of the vast amount of work that has to be done before a book emerges from its chrysalis stage as a manuscript, to the winged dignity of cloth (gilt lettering) on library shelf or table. Some eminent scientists—the Huxleys and the Tyndalls of their time—add to their intimate knowledge of their subject the gift of literary expression. Others, emphatically, do not; the *matter* is there, but not the *manner*. A text-book needs more than bare facts, it needs a sense of proportion, balance, and coherency. The average manuscript requires, almost invariably, some "editing." It has, then, in the first place, to be read "for press," a duty devolving on the publisher's Reader. It was in that capacity that my own association with "Griffin's" began, and at the risk of being tedious I would like briefly to explain what that duty involves.

The Reader has, usually, to advise as to the acceptance or otherwise of a given MS. This was not often the case at Griffin's, the procedure there being more usually to approach someone known to possess the requisite knowledge of a subject and to invite him to write a book dealing with it. In such instances I had not to "advise" as to publication: *that* was a foregone conclusion. But I had —in some cases—to avert the consequences: in other words, to turn an indifferent MS. into a good and useful book; to protect the author against himself by rectifying his little omissions; to edit; point and trim his periods, to prune and to add. References and quotations need checking; moreover, a young and enthusiastic author can get a long way off his beat, and it devolves on the Reader to bring him back; to draw his attention to the argument *non sequitur*, or to little question-begging eccentricities into which a special pleader is apt to fall. My experience has been that most authors are cordially grateful for the Reader's help; only a very small minority —of not necessarily the best—resent this useful work, which, it must be remembered, is required not only in their interest, but in that of the Publisher as well. It is the Publisher who would have to bear the financial loss, and much of the literary discredit, if he published a carelessly written or inaccurate book.

PROOF READING AND CORRECTIONS.

It cannot be too strongly emphasised that all possible corrections should be made in MS. and not deferred until the work is in proof. Printers' corrections are exceedingly expensive, and it is almost impossible to check their cost, as they may involve mechanical operations and manipulations extending over many pages and out of all proportion to their individual size and importance. The proof itself should only contain what are known as "literal" errors; mis-spellings, faulty punctuations, and so forth. These are called "printers' errors," and are not charged for. It is manifestly most unfair to the Publisher to rewrite the work in proof, and it is to avoid this contingency that the Reader reads, and, if necessary, refers the MS. back to the author for his emendations before it goes to the printer.

HOW BOOKS ARE MADE.

The remainder of the subject of preparing a MS. for press shall be dealt with in a few lines. A not unimportant consideration is the nature of the illustrations. Some have to be redrawn, some to be reduced; some are in "line," some are in "half-tone." The duty of checking the illustrations and preparing them for the engravers requires considerable knowledge and skill, and proofs have then to be transmitted for authors' revision. All this devolved on Francis Blight, and later upon a member of the staff to whom this was delegated. Let it suffice here to say that eventually the MS. goes to the printer, who returns it with the first proofs. These are read again and despatched to the author, who returns them duly corrected. If the corrections are heavy, a "revise" may be needed to make sure that they have all been effected, and that in the process no fresh errors have been introduced. Eventually the proofs are passed "for Press" and returned in "sheets" to the Publisher, who decides as to how many copies shall be bound up forthwith, and how many sets of sheets shall be kept in stock to be bound as required.

How Authors are Made.

Messrs. Charles Griffin & Co., Ltd., occupy a unique position in the publishing world, inasmuch as well over 90 per cent. of the firm's publications are technical and scientific text-books, manuals, and monographs. A small proportion of these works have gravitated automatically into their hands, the authors knowing the value of getting on to "Griffin's list," and having sent them with the hope of approval, and having had them accepted. By far the bulk of these publications are, however, the result of a painstaking selection, not of MSS., but of potential authors. "Griffin's" are in closest touch with every advancement in applied science, and with great perspicacity have secured with unerring judgment just the right author to deal with the subject they consider of sufficient importance to be served by a book. Their rule has been not to ask anyone to write for them who has published through another House, but to encourage new talent in the direction needed.

It would be interesting, but perhaps invidious to say how many—now eminent—owe that eminence to "Griffin's," and to the opportunity the firm afforded them of reaching that larger audience which only the published work can attain. When later on we refer to Mr. Francis

J. Blight, who, for a generation at least, has been, and is, synonymous with "Griffin's," it may be seen more clearly how authors are made.

Makers of Modern Technology.

It has been, for many years past, the fashion amongst a certain class of writer to decry British Science and British Technology. In the past, the charge that the British, as a nation, were unmindful of the paramount claims of technical training and education by comparison, for example, with Germany, may have been not altogether unfounded. In recent years, however, new Universities, Technical Colleges, Polytechnics, and Specialised Institutions for the teaching of Applied Science, and the promotion of Technology, have sprung up all over the country and have done much to remove the reproach that—as a nation—we are backward in these respects. It is true that some of the smaller industries still halt behind the times in these respects, but in Engineering, in all the large Iron and Steel Works, in the Textile Industries, in Medicine and Surgery, in Paper Making, in Pottery, and in many other spheres of industrial activity the enormous leeway which handicapped the latter Victorian era has been fully made up.

The basis of all technical education and training is an accurate and intelligible text-book. Without that foundation even the most efficient teacher will be, himself, more or less helpless. With the technical developments of the age the firm of Charles Griffin & Co. are, and have been for many years past, inseparably connected, inasmuch as they have consistently helped forward the progress of Technology by providing the right sort of text-book at the right time. Recently *T. P.'s Weekly*, writing of "The Great Publishing Houses," described Griffin's by the most happy phrase "Makers of Modern Technology." That summarises as no other description could hope to do the position held by the firm to-day. It is no exaggeration to claim that the firm's *imprimatur* appears on those very text-books and treatises that have served to raise British Technology from the slough in which it laboured for so long to the very pinnacle of present successful achievement and future promise. The foresight of the firm in recognising and securing the very best authors procurable, has indeed rightly earned for Charles Griffin & Co. the splendid title of *Makers of Modern Technology*.

FRANCIS JAMES BLIGHT, F.R.S.E.

To whom has this been due? It is all very well to speak of a "firm," of a "firm's" work, of a "firm's" enterprise, and of a "firm's" success. A firm is impersonal; the work, the enterprise, and the success are personal. In the case of Griffin's, as in the case of all other successful enterprises, the causes are personal causes, and the personality around whom they crystallise is that of Mr. Francis J. Blight, the Managing Director.

Francis J. Blight, F.R.S.E., whose portrait—in response to the express wishes of his colleagues—appears as a frontispiece to this volume, and whose genial personality is so well-known to many of its readers, has been for the twenty-five years which complete the Centenary of Charles Griffin & Co., Ltd., the genius presiding over the destinies of the firm; the pilot who boarded the ship during a period of storm and stress, and guided it safely into sunshine and quiet waters. It was, for several

Francis J. Blight, F.R.S.E.

The Chairman and Managing Director in his Office.

years, my privilege and pleasure to work with and for him, and I may therefore claim to speak from close personal experience. If genius be an infinite capacity for taking pains, Francis Blight's claim thereto is incontestible. His capacity for work, his energy and his assiduity are in the true spirit of the motto on his shield "*Tenax propositi vinco*," which may be freely translated "I win by sticking to my purpose."

An Ancestry of Booksellers.

Francis James Blight is a Freeman of the City of London and a Liveryman of the Stationer's Company. He is the third son of the late Gilbert Blight, who died some ten years ago at Bognor at the ripe age of 87. His grandfather, whose name was likewise Gilbert, came originally from Topsham, the old port of Exeter, with Powderham Castle, the seat of the Courtenays, just across the river. He was descended through four generations from the renowned John Blight of that place, who, in 1608, according to the "Ancient City Records," was Bailiff of the City of Exeter. Gilbert Blight, coming to London, became a Freeman of the City, and established himself with a Mr. Burrup as Law Stationers and Booksellers, Royal Exchange, Cornhill. Gilbert Blight, the younger, also a Freeman of the City of London, followed the same calling, having businesses in Gracechurch Street and, later, in Fenchurch Street. Subsequently he became associated with Edward Stanford, map publisher, where for 26 years —until his retirement—he presided over the Counting-House. He married Selina Foster, daughter of John Foster, builder, of Bristol, and her brothers James and John built the first Colston's Hall and other prominent buildings. Her cousins, John Foster—the Diocesan Architect of Bristol, whose memory is perpetuated by the stained-glass window in the Elder Chapel of Bristol Cathedral—and Canon Francis Foster, of Gloucester Cathedral, were held in much respect. Gilbert Blight's mother was Sarah Ireland, daughter of Samuel Ireland, well-known booksellers at Horsham, and the Mr. Sidney Ireland, who recently retired from the London House of the Cambridge University Press, after 40 years' service, is of the same family.

His Early Career.

The third son, the subject of this brief memoir, was born on April 22, 1858, and carries his 62 years with remarkable ease, especially having regard to the strenuous work he has always indulged in. I take the opportunity to express, on my own behalf and on that of a very wide circle of his friends, the wish that so useful a life may long be spared to further the interests of applied science in the direction he has so successfully made his own.

His early career was interesting; his first schooling was at Devizes, where the principal was a member of the Foster family, and later in London. His skill with pen and brush gave direction to his vocation as a draughtsman, and an opening presented itself at the Iron and Steel Works of Messrs. John Spencer & Son, of Newburn-on-Tyne, where his brother-in-law, Mr. Herbert Guthrie, C.E., was Works' Manager. This early experience of a great iron and steelworks has been most valuable to him, for he did not fail to make good use of his opportunities, being frequently up all night at work on the steam hammers or blast furnaces. He was, however, called back to London for still more technical work with Mr. E. M. Whitaker, architect and surveyor, who also held at the time the position of Architect to the Great Northern Railway Company. Here he had a wide and very varied experience, pursuing his studies with such success that he took his diploma in every department of drawing, as well as prizes in Science and Art Exams. It is, in this connection, interesting to record that the title page, frontispiece, and cover of the present volume are from designs of his own.

Young Blight travelled through France with his chief on a sketching tour, and was subsequently entrusted with very responsible work in connection with the construction of the Holborn Viaduct Hotel, the Holborn Town Hall, the German Lutheran Church, Soho, and other public buildings. In competition open to Great Britain, for appointment in the Architect's office under H.M. Office of Works, he only just "missed" by a slender margin of marks. He, however, secured an appointment in the Survey Department of the Land Office which brought entirely new experiences, for he had frequently to be present in the Law Courts, The House of Lords, and at the Assizes, in charge of maps, plans, and other evidence. In his leisure he devoted himself ardently to the microscope, and, applying his skill as a draughtsman, became one of the foremost microscopic draughtsmen of the day, being sought after by many of the leading physicians, and by several publishing firms. His drawings were a centre of attraction at the Soirees of the Queckett Microscopical Society, and a number of plates were published in the New Sydenham Society's Atlas.

During this period Francis Blight still found much to employ his spare time, for he had many interests. In company with a friend he tramped Wiltshire making drawings of the tumuli of Salisbury Plain, the druidical remains at Stonehenge and at Avebury, and various exhibits of interesting discoveries by excavation. These he enlarged as diagrams to illustrate a lecture which was given in various halls in London and the country. His success in lecturing on subjects as varied as the life and work of Macaulay, the poets Longfellow, Wordsworth, and Tennyson, Literature relating to Rome, the Stone Age of the Bible, and Sacred Parchments, etc., has delighted numerous audiences in the North of London, and firmly established his popularity as a Lecturer.

It was not long before the claims of technology appealed to the erstwhile Architect and Surveyor, to the young Engineer who had acquired so much of his craft as to be accepted, not as a *dilettante*, but as a serious follower in the footsteps of Wren, Watt, and Stephenson, and it may be that, in this, his "fallow time," he learned to appreciate the future prospects of that "technology" which was—even then—in the making. About this period then we find him in close association with Messrs. J. & A. Churchill, publishers, and largely responsible for the *Pharmaceutical Journal*, the *Medical Times*, and other journals, besides the authors' accounts, and the general business of publishing. His connection with the Pharmaceutical Society increased the number of his friends, amongst whom were Michael Carteighe, Professor J. Reynolds Green, F.R.S., Richard Bremridge, and one whose friendship till death he greatly valued, the late Sir Boverton Redwood. In 1894, however, came the turning point of his career. As his biographer I have to record facts; I therefore write advisedly—the turning point—not the climax, for surely the latter has not—as yet—been reached. There is nothing like "an infinite capacity for taking pains" for keeping a man perennially youthful.

His Association with "Griffin's."

To revert then to the "turning point." In 1894 Francis Blight received an invitation to join the firm of Charles Griffin & Co. Looking back over the past years, it may be seen how opportune and advantageous to both was this invitation, for "Griffin's" had, even in those days, been specialising, and had in their list many engineering and architectural works. The embryo architect and constructional engineer with literary talent, well versed in the technique of publishing and with intimate knowledge of the bookselling trade, a trained draughtsman in medical and microscopical work, was eminently qualified for the post that offered. So here we are back at the turning point, and, knowing what the Francis Blight of that day had to give, it behoves us to ascertain just what the "Griffin's" of that day sought—and obtained.

Elizabeth Eaves Griffin.*

Women had not then been accorded the prominent place in business life they now enjoy, yet we find Miss E. E. Griffin holding unchallenged sway as Chief in the business. The second child of the elder Charles Griffin, Elizabeth Eaves Griffin was little more than a girl when, in 1862, her father died, leaving a widow and ten children.

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* See Chapters II. and III. for earlier history of the firm.

She early evinced remarkable powers, and, having a natural aptitude for literary work and great business capacity, she was able during a period of considerable stress to assist the fortunes of the firm very considerably, her brothers, Richard, Charles, and Henry co-operating in the steadily growing business. She was a cultured, not to say, gifted woman, and was the author of several works, amongst which were a work of fiction entitled "A Novel with two Heroes," a life of Beethoven; a series of Essays entitled "The Masses: How shall we reach them?" and an exceedingly erudite work on the "Makers of Hellas," which was published posthumously, Dr. Frank Byron Jevons having edited the MS. and seen the proofs through the press. Miss Griffin was a German scholar, and was conversant with French and Greek. It was she who first recognised the great capacity latent in Francis Blight, to whom, between the time of his appointment in 1894 and that of her death in 1899, she delegated more and more of her duties, relinquishing in his favour responsibilities which, with her failing health, were rapidly becoming more than she could manage, but which she fully recognised were well within the scope of his ability to shoulder. Indeed it is not little to her credit that she had the breadth of mind and insight fully to appreciate how valuable was the new accession to the firm, and how inseparably its fortunes were linked up with his.

In 1891, for family reasons, the firm had been converted into a Limited Liability Company, of which Miss E. E. Griffin was Managing Director, Richard T. Griffin and Hy. Brougham Griffin, Directors, and Charles J. Griffin, Secretary. Richard T. Griffin devoted all his energies to the counting-house, whilst Charles was responsible

Elizabeth Eaves Griffin

Head of the Business and Managing Director 1891 to 1899.

for the travelling, and Henry edited the Year Book of Scientific and Learned Societies and also attended to the advertising. It was the death of Richard and Henry which necessitated the calling in of help from without, and on Miss Griffin's death in 1899 Mr. Blight was appointed Chairman and Managing Director, a position to which he has been continuously re-appointed.

At the time of this election Mr. Blight's Co-Directors were Charles J. Griffin and Miss Helen F. Griffin. In 1907, however, Charles J. Griffin died, and his son, Charles Rae Griffin, who had entered the service of the firm some years before, was made a Director in his father's stead. A little later Mr. Blight's only son, Horace, who had qualified as a Chartered Accountant, relinquished his profession to become, at the request of the Griffin family, Secretary and, shortly after, a Director of the Company. Under that Directorate seven years of unremitting labour in most happy accord lifted the business to a height of prosperity never known before, when on August 4, 1914, war was declared and the whole business world shaken to its foundation.

This was a time of severe stress and strain, for the great black cloud of war obscured the future. It was well that the head of "Griffin's" was a man of vision, character, and determination. His energy found expression in broad administrative issues without neglect of detail. With keen business acumen he sent his Traveller out to the great centres of industry at a time when other publishers were calling theirs' home. With corresponding foresight he issued broadcast to the Trade a letter setting forth the immense importance of technical books at that juncture of National affairs, and drawing attention to the magnificent supplies "Griffin's" had at command. He urged upon the Admiralty, the War Office, the Royal Air Force, the Board of Trade, and the manifold branches of the Ministry of Munitions the absolute necessity of drawing upon "Griffin's" for the books essential to the new technique of armaments which had sprung into being. The reward was immediate. Such a rush of business followed that had it not been for the devotion of the whole Staff it would scarcely have been possible to cope with it. The labour of years found sudden fruition, and, as one eminent leader remarked, "Griffin's books proved as valuable as munitions."

It is not too much to say that they were one of the safeguards of the country. Tens of thousands of copies were sold, and, thanks to the most friendly relations which Griffin's enjoy with paper merchants, printers, and binders, as fast as editions were exhausted they were replaced to meet the continuous demand. So vastly important did the Managing Director of the Company regard the supply of these books that he repeatedly urged before the Tribunal the vital necessity of retaining his Co-Director, Mr. C. R. Griffin, and again and again was he spared to him. It was not until March, 1917, that he was at last refused further exemption, and thereafter the Managing Director was left to face the great responsibility alone, for his only son had left quite early in the war.

Charles Rae Griffin.

Mr. C. R. Griffin's inclination has always been towards mechanical engineering, and after leaving Tonbridge School he went through a course of special training in engineering and electricity, and subsequently gained

Charles Rae Griffin
The Fifth Generation in the Business. Director 1907

knowledge and experience of the publishing business in two other well-known firms. This enabled him to enter with confidence upon his duties with the House of Griffin, and his place upon the Board of Directors was assured. For some years he has shared the responsibility of the oversight of the business, having the supervision of the Reading Department and the firm's advertising. As an amateur photographer he has been very successful, and has won many prizes. The portrait of H. V. Blight in this volume is his work. In 1917 he joined the Royal Naval Air Service, in which his mechanical knowledge proved of value and was turned to good account in the control of technical supplies.

HORACE V. BLIGHT, A.C.A.,

the only son of the Chairman of the Company, after serving as a Special Constable during the early months of the war, volunteered in response to Government appeals for Chartered Accountants, was accepted, and gazetted a Lieutenant in September, 1915. He served at Avonmouth and at G.H.Q., France, and at both places was reported "Indispensable." Repeatedly he was Acting-Captain at rail-heads in France, but, in the winter of 1917, he was transferred to the infantry and sent home for training. At that very time advertisements were still appearing daily for Accountants, but his qualifications were disregarded. He applied himself with his usual thoroughness and enthusiasm to his new tasks, and succeeded so well that by April 19, 1918, he found himself attached to the Royal Fusiliers and sent to France, where he was almost immediately passed up the line and stationed as O.C. at an outpost within a hundred yards of the enemy.

His sunny comradeship, gallant bearing, and fearless leadership won him a host of friends and Captain Noel Mellish, V.C., C.F., wrote of him "his keenness and charm of manner would have ensured for him the love and respect of both officers and men in any unit." He won the Military Cross, but in a later brilliant attack at midnight, June 15th, 1918, was shot dead beyond the German machine gun nest which he had succeeded in taking. He left a widow and a daughter of four years, and it is pathetic to record that, ten days after his death, a son, John Horace Blight, was born to continue the family name. Tributes to his memory appeared in *The British Roll of Honour*, *The Publishers' Circular*, *The Baptist Times and Freeman*, and in *Merchant Taylor's School Magazine*, besides several technical papers.

ARTHUR DOWNER,

the son-in-law of the Chairman, after serving on many battle fronts during the war, has been appointed as Secretary to the Company, and the door to the vacant place at the Board of Directors stands invitingly open to him. The appointment was first offered to John Arthur Griffin, son of John Joseph Griffin, of Cape Colony, but for various reasons had been declined.

A new generation have now entered into the rich heritage of the past. Not only John Horace Blight, but Charles Rae Griffin, Junr., and his brother, John Oswald Griffin, are in the succession, so there is

"A seedling gem,
Worthy such noble stem,
Gaily to bourgeon and broadly to grow."

Horace Vincent Blight, M.C., A.C.A.

Director and Secretary of the Company. Killed in Action in France, June 15. 1918.

THE STAFF.

From the foregoing it will readily be inferred that with a Managing Director who acts on the principle that " a thing well planned is half-done," Griffin's Staff is thoroughly efficient, well-proportioned, and capable of expanding with the growing need. There is the spirit of Scottish clanship about it, and absolute loyalty to the Chief. *Quis separabit nos* was a well chosen motto. Each member has his specific duties, and is conscious of being trusted to perform them with his utmost ability. There is no overlapping or confusion, and everything works with well-regulated exactness. Such is the Staff to-day, and such it was in my time, and I welcome this opportunity of bearing my testimony to the unqualified happiness of the years during which I was associated with them in the work, for I received nothing but courtesy, kindness, and generous consideration, and it would be difficult for me to speak too highly of such comradeship.

An immediate colleague of my own, and my fellow Reader, now passed away, was a gentleman of mature age—he had been thirty years with " Griffin's "—a man of wide erudition and an acknowledged authority on natural science. He possessed extensive knowledge of bacteriology, botany, geology, and climatology, and authors have many times thanked him for his friendly help and valuable advice when reading their manuscripts for press.

One other, who has died since my time, I may just refer to. " Old Adam," as we familiarly called him, was a quaint old servitor, just such a character as Dickens would have delighted to depict. His attachment to " Griffin's " when in Glasgow was such that, on finding he was likely to be left behind on the removal of the firm to London, he set off, unknown to the Chiefs, walked all the way—supporting himself *en route* by fiddling to the villagers—and in due course turned up at the new premises in London! Such faithfulness in his, as in other cases, was not forgotten in his old age.

Though there are fresh faces to be seen in the office and warehouses of Griffin's to-day, yet there are several members of the Staff whose service covers twenty-five to thirty years, and these "old-timers" have been the mainstay of the business during the stress of war. Inspired by the example of their Chief, they voluntarily gave up holidays and begged to be allowed to work late in the evenings, frequently sacrificing their Saturday afternoons rather than let the work fall into arrears. This is a fine testimony to the happy relations subsisting between the Staff and the Chiefs. Such devotion deserves to be placed on record, and the services of Mr. Alfred Figg, Mr. James H. Sims, and Mr. Arthur Flowerdew should be mentioned in this respect.

The quiet routine of counter-work is occasionally upset through curious misunderstanding of the titles of books, as, for instance, when "Suction Gas Plants" was seriously asked for as a book on botany; "A Text-book of Physics" as a medical book, or "Problems in Land and Mine Surveying" as "Problems in Heart and Mind Surveying!" Occasionally enquiries by letter are somewhat startling, as when a certain Journal for Nurses asked for a "review copy" of Archbutt and Deeley's "Lubrication and Lubricants," and a certain amount of incongruity would appear involved in the suggestion, once made to the firm, to publish Louis Wain's "Annual."

Arthur Downer.

Secretary of the Company. Son-in-law of the Chairman

But though of recent years the catalogue has not lent itself to humour, there is nothing dull or gloomy at "Griffin's." There are smiles on all faces, and the hearty laughter of the late Horace Blight was irrepressible, and could be heard at times from the bottom to the top of the premises. Possibly this light-heartedness contributed to his popularity in the House—certainly "technology" failed to repress it.

Griffin's and the Technical Press.

That Griffin's have won their way in the estimation of the Scientific and Technical Press is evident by the constant references to the high quality of their output. The firm is neither unmindful nor unthankful for the generous eulogies so bountifully bestowed, and its endeavour has always been to deserve them. One reference embodying a high compliment may be specially quoted in this connection. It is from the *Railway Official Gazette*, and runs as follows :—

> "With books of a technical nature, it is of great importance to note the name of the publisher, as this alone may be a guide to the value of the contents. The author may be entirely unknown, but if a book on a technical subject bears the imprint of such a firm as Charles Griffin & Co., Ltd., it is a guarantee that the contents are valuable."

During the war "Griffin's" books were again and again spoken of in reviews as being of the utmost national importance, but perhaps the greatest compliment of all came from the United States of America when they entered the war and the submarine menace was at its height, for they ordered a very large number of a certain book (over 300 pp.), asking whether, if copies could not be sent immediately, they might reproduce the work over there photographically! Fortunately many hundreds of copies dodged the submarines, and, in the end, doubtless helped materially to overcome them. The American interests of Messrs. Charles Griffin & Co., Ltd., are cared for by several Houses, but chiefly by J. B. Lippincott Company, between whom and the British firm the most cordial relations of many years' standing subsist.

"Griffin's" Tree and its Fruit.

Griffin's trade-mark, which appears upon the Company's seal, is a wide-spreading tree with the suggestive motto *Quis separabit nos.* With its roots deep down in the past it has withstood the shock of tempest and of war, and shows increasing strength and vigour with the passing of years. The tree is known by its fruit; during the last quarter of a century this tree has produced a harvest far exceeding in value that of the earlier years. The grafting of its present Managing Director on to the old stock has proved of great value, and has rejuvenated the whole tree. On previous pages is given some indication of his business worth. Although he seldom speaks of politics or religion during the hours of business, yet he holds firm convictions in both. He is not unknown in a certain Committee-Room at Westminster, and references in the press reveal that he is a leading London Baptist. He is a past-President of the Western Group of the London Baptist Association, and for many years served as Hon. Secretary, he is Vice-Chairman of the Council of the London Baptist Missionary Union, and a member of the

Committee of Regent's Park College (University of London). All his life he has been an earnest Sunday-School worker, and has spoken at a Session of the Baptist Union of Great Britain and Ireland. These facts, coupled with his business career, testify to the intensity of his life, yet he makes time to attend meetings of quite a number of Scientific Societies, in addition to those of the Devonshire Association for the Advancement of Science and Art, of which he, proud of his Devonshire descent, is a life-member.

CONCLUSION.

A spirit of freedom and of enterprise has characterised "Griffin's" from early days, and when, in 1896, the Publishers' Association was founded, they stood aloof as they had specialised upon technical subjects and desired to be untramelled. This spirit of independence led them to act upon the NET system long before *The Times* controversy and the adoption of such terms for general publications. They have, from the earliest days, favoured Scientific and Technical publishing, and their more recent history has consolidated their position in this respect. They are proud that, as Makers of Modern Technology, they have filled so useful a place in National progress, and though they have not sought public or official recognition, they face the NEW AGE fully conscious that it devolves upon them to take a prominent part in the advancement of all branches of applied science, and to bring into harmonious working the great National industries. Towards this consummation they have worked steadily and achieved greatly. Their present-day books are instinct with the spirit of reconstruction, and

"Griffin's" and its esteemed Chairman, Francis J. Blight, may be said worthily to exemplify, both in the present and in their promise of the future, Browning's beautiful lines:—

> "Grow old along with me!
> The best is yet to be,
> The last of life for which the first was made!"

Rev. THOMAS HANNAN, M.A.

Chapter II.

GLASGOW AND CHARLES GRIFFIN & CO.'S ASSOCIATION WITH IT.

By the Rev. THOMAS HANNAN, M.A., Hon. C.F., F.S.A. Scot.

Griffin's early Association with Glasgow—Present and Past Compared—Glasgow To-day—Glasgow in the Sixties—Glasgow in Literature—Glasgow Printers—The Pioneer of Technical Education—The Pioneer Firm of Technical Publications—Joseph Griffin the Founder—Richard T. Griffin and John J. Griffin—London training with Tegg & Co.—Continental Studies—Griffin's name in Glasgow Directory for 1820—Griffin's Public Library in Glasgow—Griffin and the *Scots Times*—Charles Griffin born 1820—Interesting Relics of Early Days—Griffin's Edition of the Encyclopædia Metropolitana—Removal to London, 1848—John and Charles dissolve Partnership, 1852—Charles Griffin Publisher to the University of Glasgow.

ERRATA.

P. 54, line 6 to line 10 should read—"The first number of the *Glasgow Advertiser* appeared on Monday, January 27, 1783. At a date not at present known the title became the *Glasgow Advertiser and Evening Intelligencer;* on Friday, January 24, 1794, the original title of the *Glasgow Advertiser* was resumed. On November 1, 1802, the title was first used of *Herald and Advertiser*. On August 23, 1805, the name became the *Glasgow Herald*."

P. 56, fourth last line—for *History of Glasgow* read *History of Glasgow University*.

P. 71, second last line—for "Peebleshire" read "Selkirkshire."

73, third last line—for "poetical works" read "political works."

Chapter II.

GLASGOW AND CHARLES GRIFFIN & CO.'S ASSOCIATION WITH IT.

THE MAKERS OF MODERN TECHNOLOGY.

IN the realm of Applied Science to-day, in Glasgow as in London and other great cities, the House of Charles Griffin & Co. is pre-eminent. Although, like other publishing houses, it felt the call of the Metropolis of the Empire, which may be described as in many senses the Metropolis of the World, yet it has maintained its Scottish associations, and Glasgow is not without a considerable debt to the House for books which have contributed to the growth and advancement of the city in all departments of industry.

Long after the House had removed its centre to London, its direct connection with Glasgow was retained in the circumstance that Charles Griffin & Co. continued to be publishers to the University. And that marks a very close connection, for in Scotland, more than in England, the University is identified with the life and the work of the city in which it has its habitation. This long association has contributed largely to the fact that, even when the House ceased to be publishers to the University of Glasgow, the severance did not produce that separation of interest which might have been feared. Glasgow is a city of craftsmanship, and of the technical knowledge on which eminence in craftsmanship is built; and Charles Griffin & Co. are always first, or among the first, in providing the most complete technical knowledge which can be brought to bear on any industry.

The "centenary celebration" is now an established custom; and no Firm has a better right to celebrate its centenary than this fine Publishing House. This statement does not spring from unreasoning adulation. As a boy in Glasgow—which is not my native place, but was at an early age my place of residence—almost my earliest recollection of books was of those with the imprint of Richard Griffin & Co. The House observes its centenary in 1920. It might indeed have adopted an earlier date, for the business was in existence long before the year 1820. But it takes as its date of origin as a *publishing* House that year, in which it was described as "booksellers and publishers;" and the imprint of that year is extant. As Glasgow has grown and prospered, so has the publishing House.

PRESENT AND PAST COMPARED.

It requires considerable imagination to picture what Glasgow was one hundred years ago; and it is still more difficult to form a mental image of what it was in earlier days than that; yet, to appreciate Griffin's association with the city, and the breadth of influence arising from that association, it will be well to glance at the present wide-spreading branches of the tree which is the badge or "device" of its greatness, and to note the part which technical books have had in its growth. The political influence of the city, the length and breadth of its extent, the splendour of its buildings, and the beauty of its

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Orders for Exportation executed with promptitude and correctness.

suburbs, the vastness of its industries, the enormous shipyards and ironworks of the Clyde, its municipal enterprise—for example, the Loch Katrine water scheme, and the Electric Tramway system which has proved so great a financial asset—are the wonder and envy of many great cities.

Technical books have been at the root of all this, and Griffin's part has been very notable. One of the modern benefactions to the city is the palatial Mitchell Library—a gift of nearly £67,000 from Mr. Stephen Mitchell; and that is only one of many libraries, for since the introduction of the Free Libraries Act, District Libraries have been established on all sides. It is worth remembering that Griffin's Public Library existed in 1821, the forerunner of all these.

Glasgow To-day.

Glasgow to-day returns fifteen members to the House of Commons, as compared with eleven for Liverpool, ten for Manchester, and five for Edinburgh. It has three great railway passenger stations, miles of wharves and docks along the River Clyde, and the finest shipbuilding yards in the world along both sides of the river—Govan on the south side, and from Partick to Dalmuir on the opposite side. It has many thoroughfares remarkable for their length—Renfield Street, Union Street, Jamaica Street, Eglinton Street, and Victoria Road, running in almost a straight line from north to south, from Cowcaddens to Crosshill; Gallowgate, Trongate, Argyle Street, and Dumbarton Road, from east to west; Parliamentary Road and Sauchiehall Street, also from east to west, from the grand old Cathedral to the junction of Sauchiehall

THE UNIVERSITY, GLASGOW.

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Street with Dumbarton Road; New City Road still further north, running from Cowcaddens in a straight line, becoming Great Western Road, and ultimately joining Dumbarton Road several miles west of the junction of the other great arteries with that road. From Kelvin Bridge, on the Great Western Road, by New City Road, Sauchiehall Street, Buchanan Street, Argyle Street, and Trongate, to Glasgow Cross, a walk entirely in the interior of modern Glasgow, is comparable in distance and character with a walk in London from the Marble Arch to Broad Street Station by Oxford Street and Holborn.

The limits of space forbid any description of the magnificent modern buildings—such as the Royal Infirmary, which was the Queen Victoria Memorial, costing over one million pounds; the St. Andrew's Halls; the Municipal Buildings; the Art Galleries; the University; the Western Infirmary, adjacent to the University; the Public Schools of the Education Authority; the magnificent Royal Technical College, in which Charles Griffin & Co.'s publications bulk largely; and many other buildings worthy of individual mention.

We turn to those of former ages, and the outstanding building is the beautiful Cathedral dedicated to St. Mungo, the Patron Saint of Glasgow. The oldest part dates from 1197. But next to this in age, and known only to a few, is "Provand's Lordship," dating from 1471 and 1670, and still inhabited. It stands almost opposite the Cathedral, with which it is historically associated.

Glasgow in the Sixties.

It is not long since the "sixties;" yet the Glasgow of to-day is in great contrast with the Glasgow of that recent period. My earliest recollections are associated with the old "qualified" chapel of the Episcopalians in Renfield Street, on a site which has been occupied by business buildings since about 1871. I remember very little about the church except its double-decker pulpit and its galleries; but I have a vivid recollection of an old man gaudily bedecked with a very long gold chain which seemed almost to be wound round him, and wearing many gold rings. My father introduced me to him outside the church one Sunday, which must have been a great honour, as he was "John Sobieski Stolberg Stuart, Count d'Albany." I did not realise anything about his personality except that he was an old gentleman who had no resources, and who paid periodical visits to Scotland, receiving hospitality from a number of old county families of the Jacobite tradition. He died in 1872, and it was only recently, on comparing notes with the present Bishop of Glasgow and exchanging reminiscences of the old church, that I learned who the old gentleman was.

In those distant days there were no trams, and my father used to take me Sunday afternoon walks among green fields and the woods of the ravine of the River Kelvin—all now covered with miles of streets and houses. Glasgow was small then compared with the present day, and I can remember numerous "characters"—such as "Old Malabar," the street acrobat, whom I never saw do anything acrobatic; "Campbell Blair's Teapot," a quaint man who stood outside a tea merchant's in Jamaica Street holding out newspapers in one hand while the other rested on his hip with a curve like that of a teapot handle; and many others. The present age does not encourage such oddities.

Glasgow Art Galleries.

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In those days Glasgow was industrious and wealthy; but it had also been so when it was still smaller than in the sixties. I saw it grow rapidly. I remember when the horse-tramways began to run, about the year 1872—and I greatly envied the trace-boys who took the cars up the Renfield Street hill, as they were mounted on saddled horses. I played with the beginnings of the telephone at school as a laboratory toy about 1879 or 1880, and wondered at the glory of the electric light as developed in a vacuum glass in the same laboratory. In those days technical knowledge was making great strides; "Anderson's College," which is now the "Royal Technical College," was doing striking work outside the University; and Charles Griffin & Co.'s publications were everywhere in great demand.

Glasgow in Literature.

If we consult the pages of Sir Walter Scott's "Rob Roy" we shall get an idea of the importance of Glasgow in the days succeeding the Revolution. He gives the course of his travellers on their way from England to the city—"One chain of barren and uninteresting hills succeeded another, until the more fertile Vale of Clyde opened upon us; and with such dispatch as we might we gained the town, or, as my guide pertinaciously termed it, the city of Glasgow. Of late years, I understand, it has fully deserved the name, which, by a sort of political second sight, my guide assigned to it. An extensive and increasing trade with the West Indies and American colonies has, if I am rightly informed, laid the foundation of wealth and prosperity which, if carefully built upon and strengthened, may one day support an immense fabric of commercial prosperity; but in the earlier time of which I speak, the dawn of this splendour had not arisen. The Union had, indeed, opened to Scotland the trade of the English Colonies; but, betwixt want of capital and the national jealousy of the English, the merchants of Scotland were as yet excluded in a great measure from the exercise of the privileges which that memorable treaty conferred on them. Glasgow lay on the wrong side of the island for participating in the east country or continental trade by which the trifling commerce as yet possessed by Scotland chiefly supported itself. Yet, though she then gave small promise of the commercial eminence to which, I am informed, she seems now likely one day to attain, Glasgow, as the principal central town of the western district of Scotland, was a place of considerable rank and importance. The broad and brimming Clyde which flows so near its walls gave the means of an inland navigation of some importance. Not only the fertile plains in its immediate neighbourhood, but the districts of Ayr and Dumfries, regarded Glasgow as their capital, to which they transmitted their produce, and received in return such necessaries and luxuries as their consumption required."

The "political second sight" of calling Glasgow a city is a strange phrase for Sir Walter Scott to use, whether he used the phrase as author or in the personality of his creation, Andrew Fairservice; for Glasgow had always been a city by virtue of its being the seat of a Bishop. This, however, is merely an interjected comment.

After describing the reluctance of the Highlander to leave his mountain home, the chapter—which is the nineteenth—proceeds: "Yet even then the mountain

THE

TOPOGRAPHICAL Picture of Glasgow

IN ITS

ANCIENT AND MODERN STATE;

WITH

SKETCHES OF A TOUR

TO

The Lakes and Romantic Scenery

IN THE SHIRES OF

Dumbarton, Argyll, and Perth,

AND TO

THE FALLS OF CLYDE.

◆

Third Edition, Enlarged.

EMBELLISHED WITH THREE VIEWS AND TWO MAPS.

◆

Glasgow:
PRINTED BY R. CHAPMAN,
FOR RICHARD GRIFFIN & CO., HUTCHESON-STREET.

1822.

glens were over-peopled, although thinned occasionally by famine or by the sword, and many of their inhabitants strayed down to Glasgow, there formed settlements, there sought and found employment, although different indeed from that of their native hills. The supply of a hardy and useful population was of consequence to the prosperity of the place, furnished the means of carrying on the few manufactures which the town already boasted, and laid the foundation of its future prosperity."

The appearance of the city is thus described—" The exterior of the city corresponded with these promising circumstances. The principal street was broad and important, decorated with public buildings, of an architecture rather striking than correct in point of taste, and running between rows of tall houses built of stone, the fronts of which were occasionally richly ornamented with mason-work—a circumstance which gave the street an imposing air of dignity and grandeur, of which most English towns are in some measure deprived, by the slight, unsubstantial, and perishable quality and appearance of the bricks with which they are constructed."

In the period covered by the novel, printing had not very long been established as a Glasgow industry; and yet, as we shall see presently, at least one man had been able to become wealthy by the art. These extracts give an idea of the size of Glasgow about two hundred years ago; and the description of its appearance is a testimony to the fact that it was a prosperous place.

At a date a little later the prosperity of the city, suggested in one of the above paragraphs as about to come, was so fully realised that the city possessed its " merchant princes," who were very arrogant, and were very largely the "tobacco lords" of a great Virginian trade, demanding precedence on the "plainstanes" or footpaths, and apparelling themselves and their families most gorgeously.

But if we go back to an earlier epoch, that of Charles I. and Cromwell, we find ourselves in a very interesting setting in the city of Glasgow. I know of no work of literature, in history or romance, which gives so beautiful and so striking a picture of it as James Grant gave in his historical romance of "Harry Ogilvie, or the Black Dragoon." Grant wrote the most stirring Scottish historical romances in the sixties and the seventies of the nineteenth century; yet I hardly find any person who has read them. They are forgotten, but are well worthy of being revived,

In "Harry Ogilvie" the Glasgow of the picturesque period is shown—the gaiety of youth in contrast with the strange religious sourness which was a characteristic of the ruling factions of the time. The old "College" is still residential, as Oxford and Cambridge remain, while the Scottish Universities have departed entirely from the community life. The students go about unlighted streets, and armed retainers of the great Argyll make ambushed attacks on those whom their master desires to get out of the way. That famous character in Scottish ecclesiastical history, Zachary Boyd, author of a work with the cheerful title of "The Last Battell of the Soule in Death," lives before us as minister of the Barony Parish, Rector and Vice-Chancellor of the University, chiding and loving the too lively student who is the hero of the story, and presenting him with his historical work to read instead of romances of love and war. The famous incident of Zachary soundly rating Cromwell in person in a sermon in Glasgow Cathedral in 1650 is made to live before our eyes; and even his "Last Battell of the Soule in Death" is shown to be a popular work, creating a taste in literature which survived down to the days of the early activity of the House of Griffin, which published for the consumption of the Glasgow reading public a large number of religious works of somewhat similar strain, such as Joseph Alleine's "Alarm to the Unconverted," and Essays on Doddridge's "Rise and Progress of Religion in the Soul." The former of these was first published in 1672, having its title changed at a later date to "A Sure Guide to Heaven," and the latter was first published in 1745; so they both belong approximately to the same type of spiritual devotion, and one of them practically to the same period of time. The activity of the House of Griffin in the publication and re-publication of works of that type gives us a very clear insight into the cast of religious thought which prevailed in Glasgow well into the middle of the last century.

Glasgow Printers.

It was in the time of Zachary Boyd that Glasgow obtained a printer for itself for the first time. Edinburgh had established itself as a printing and publishing centre for Scotland; but Glasgow must at last have determined that it would make a bid to rival Edinburgh in this art and industry. So George Anderson was invited by the magistrates of Glasgow to leave Edinburgh and to establish himself in Glasgow as the city printer. This he did in 1638, and continued in Glasgow until his death in 1648. In 1656 the magistrates invited his son, Andrew, to the

THE
PRINCIPLES
OF
MORAL AND POLITICAL
PHILOSOPHY.

By WILLIAM PALEY, D.D.

SUBDEAN OF LINCOLN, PREBENDARY OF SAINT PAUL'S, AND
RECTOR OF BISHOP-WEARMOUTH.

A New Edition, Corrected and Revised.

LONDON:
PRINTED FOR BALDWYN & CO. NEWGATE STREET; R. GRIFFIN & CO.
GLASGOW; AND J. CARFRAE, EDINBURGH.

1821.

city from Edinburgh, giving him a subsidy; but he returned to Edinburgh in 1661, and then Robert Sanders became "Printer to the City." In his case printing must have been very successful, for he became wealthy. He died in 1696, and was succeeded by his son Robert.

Printing continued to flourish, and Glasgow became a publishing centre to such an extent that the Press of the city obtained a European reputation under Robert and Andrew Foulis from 1741 onward. That the typographic art has not declined in Glasgow is evinced by this volume, which is produced by Messrs. Bell & Bain, Limited, of that city, and it is gratifying that a friendship commenced when the House of Griffin was in Glasgow is continued between the two Firms to the present day.

The era of machinery and of technical knowledge began in the time of Robert and Andrew Foulis. In 1768 Arkwright invented the "spinning-jenny," and set up a mill at Preston. Glasgow was a centre of the hand-loom weaving industry; and it was not long until it had mills in its neighbourhood. In the era of trade expansion which ensued, it is worth noting that it was these mills which produced the great David Livingstone, whose grandfather, on the break-up of the Highland clans which followed the rebellion of "the forty-five," left the island of Ulva, near the larger island of Mull, for the Blantyre mills in 1792, giving up his Gaelic name of Mac-an-Leigh or Macleay and taking the well-known name of Livingstone. David Livingstone himself worked in those Blantyre mills, and on his first visit from his exploring expeditions, when he lectured in Blantyre, his chairman was his former employer, James Hannan.

The Pioneer of Technical Education.

The pioneer of technical education in the world appeared in Glasgow. This was John Anderson, Professor of Natural Philosophy in the University. In his early efforts he carried on classes for employers and their workmen; and when he died he left his fortune for the foundation of "Anderson's University"—"for the good of mankind and the improvement of science in an Institution to be denominated Anderson's University." This University has done an immense work in Glasgow, and it is beyond doubt that the industrial development of the city has been greatly advanced by the foresight of that really gifted man. He saw far before his time; but his example was largely taken up in many directions. It used to be accepted in recent times that Germany was the leading country of the world in technical education. The belief grew because the Germans said so, and because many people went to Germany to see the great things there without having seen the greater things at home. And then they came back, after having been carefully led round by German officials, and they declared that we had nothing at home to equal the German technical schools. They proclaimed that the Germans had invented technical education, and that we must copy them.

The truth is that Anderson's effort began technical education for the world. Anderson died in 1796, and one of his successors in the work was Dr. George Birkbeck, who formed a "Mechanics' Class," which developed into the "Mechanics' Institution." Slightly later than Anderson's movement was the French "Ecole Polytechnique;" and on these two movements was built up the whole Polytechnic system. Germany copied France and Britain, and then proclaimed that she had invented the technical system of instruction. On a comparison, there is far more technical education of a high order in Britain than in Germany. Anderson's University is now the "Royal Technical College," with magnificent buildings and equipment, but yet only one among many in the country, though equal to the great College at Charlottenburg of Germany's capital; while Glasgow is only a provincial city.

Industry and books have gone together in the Scottish city of money-making, and, in 1791, Walter Stirling founded Stirling's Library, which is now amalgamated with the Mitchell Library and the great Public Library of the city.

THE PIONEER FIRM OF TECHNICAL PUBLICATIONS.

The pioneer Firm of technical publications arose about the same time and in the same place—and that is the Firm of Charles Griffin & Co., which has attained to-day, under its present direction, the high position which its early history presaged. Just as Professor Anderson, with his technical instruction, has exercised a powerful influence in giving momentum to the industrial prosperity of Glasgow in days that are past, and by his generous foundation continues that influence, so the House of Griffin has also contributed to that industrial progress by the long succession of works bearing on the technical aspects of the industries of Glasgow which have issued from its Press. It began largely with the production of works on religion, poetry, general literature, and education in its general aspects. Gradually it concentrated its energies on technical education. It might as easily

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The Times and Courier daily London, and the Glasgow and Ayr Newspapers, are received at the Library for the perusal of Subscribers.

The Appendix to the General Catalogue, containing nearly 1000 *Volumes which have been added to the Library during the last nine months, is now ready for delivery.*

FOLIOS OF CARICATURES LENT OUT FOR THE EVENING.

have become the great House for fiction, but it elected to direct its capacities to technical work; and it has been phenomenally successful, though that success has been achieved, perhaps, without the same amount of public consciousness as if the Firm had aimed at producing striking works of fiction.

In the period when the House of Griffin had its origin, Glasgow had great men in abundance. Thomas Telford had shown himself a great engineer by his building of Glasgow Bridge. Henry Bell had applied the motive power of steam to transport by water in substitution of the venerable method of catching the wind in pieces of canvas. He had conceived the idea of going straight to the vessel's destination by his motive power of steam, instead of the slow method of arriving by means of a long series of tacks from point to point. The "Comet," although a crude effort, justified the theory, and was the mother—for a ship is always "she"—of all the magnificent liners which plough the ocean. He was indebted for his motive power to James Watt, more famous still in Glasgow. And among those who were distinguished in other directions was Sir John Moore, the hero of Corunna, the only native of Glasgow among those just mentioned. The greatness of Glasgow, and her hospitality to those who were men of enterprise, attracted to her service numbers who were not her sons by birth.

Joseph Griffin was doubtless among those, not sons by birth, whom the ancient city attracted. I assume this, because the name is not Scottish, and it is a common baptismal name in Wales. Scottish names are peculiarly easy to recognise if one is a Scotsman himself and has given a certain amount of study to the subject—although

THE

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OF

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Glasgow:
PUBLISHED BY RICHARD GRIFFIN & CO.
64, HUTCHESON STREET.

MDCCCXXVI.

there are some which are very deceptive. For example, few people would say that Mortimer and Vipont are anything but English names derived from the Normans; yet they are quite Scottish, as tested by their ancient occurrence in Scotland, and by association with great Scottish estates in the feudal days. The surname of Griffin is familiar to me through the dramatist, Gerald Griffin, born 1803; and he was an Irishman, a novelist and poet as well as a dramatist. His novel, *The Collegians*, published anonymously, is a very clever piece of work, and gave Dion Boucicault the material for his famous play, *The Colleen Bawn*.

Whether Joseph Griffin were an Englishman, a Welshman, an Irishman, or a Scotsman descended from any of these nationalities, he was, at any rate, a successful merchant of Glasgow in 1795, carrying on business in Nile Street, which is now known as West Nile Street, and which was then a great business centre in the comparatively recent extension of the city from its former boundaries. It is still a great business centre, doing immensely more business than in those days, but rather a centre of great warehouses than of fashionable shops. In 1795 it must have been a resort of fashion and of intellect. Joseph Griffin combined bookselling with his other business. The population of Glasgow was then about 75,000, as compared with its present population of over one million inhabitants. A large and important section of his business was the sale of philosophical instruments, scientific appliances, and chemical apparatus; so with bookselling and other goods the business must have been one of much importance and of considerable leading

The combination of bookselling with the sale of the

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OF

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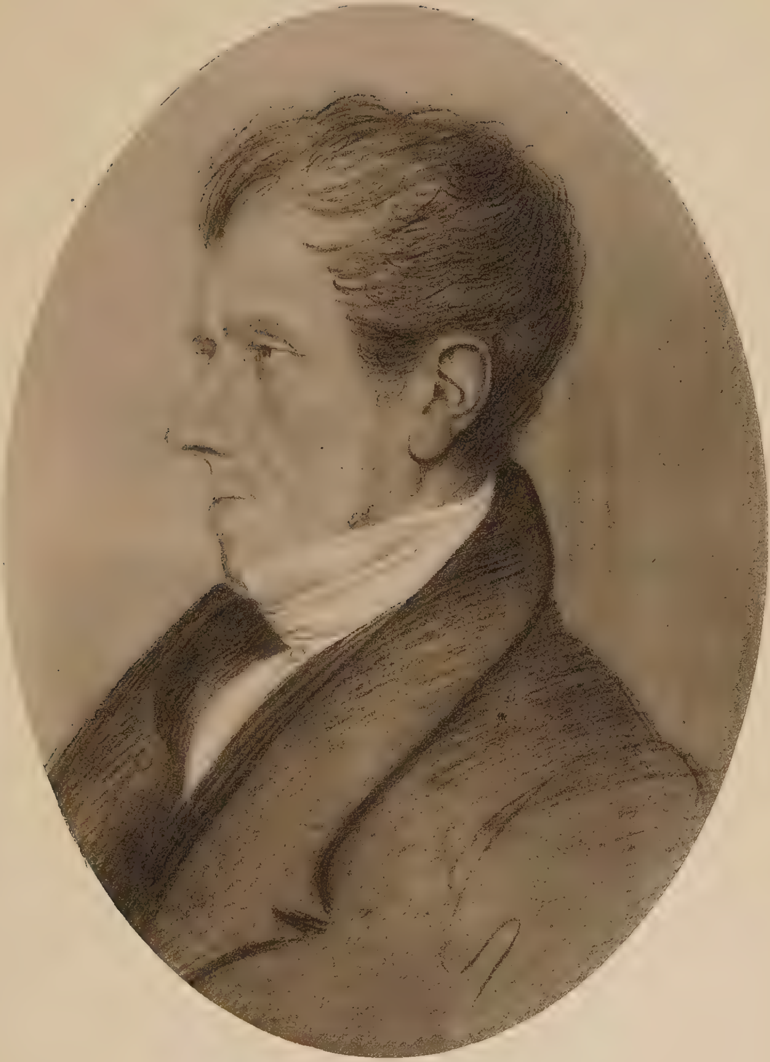
appliances of natural philosophy and chemistry is one which ought to be noted in considering the history of the development of the House of Griffin. It gave a direction to the bookselling branch which communicated itself to the publishing branch, and ultimately led the Firm to devote itself specially to technical and scientific books. By a perfectly natural process of evolution it thus led to the present eminent position of the House as one of the foremost, if not absolutely the foremost, in this important division of the publishing field.

Joseph Griffin had two sons, Richard Thomas and John Joseph. He had other children, but these two sons are those who come into the story of the Firm. Richard Thomas was probably born about the year 1790, and John Joseph was born in 1802. Richard Thomas seems to have evinced a great interest in the bookselling branch of the business, and to have gradually taken it under his direct and special care until it became quite as important as the original business to which it had been added. Assuming the date of his birth to have been as stated, he probably entered the business about the age of fifteen years, according to a custom which prevails in Glasgow to the present time with very little modification. In Glasgow Academy, which is the great school of Glasgow at the present time, hardly any boy remains beyond the age of sixteen if he is going to embark on a business career. The idea of the astute Glasgow merchant is—if my boy is going into business let him get there before he ceases to be a boy and becomes too proud to do the work that symbolises the beginning of business.

If Richard Thomas entered the business at the age suggested, he must have been in it about the year 1805,



Richard Thomas Griffin, 1790-1832.

Married Mary Eaves.

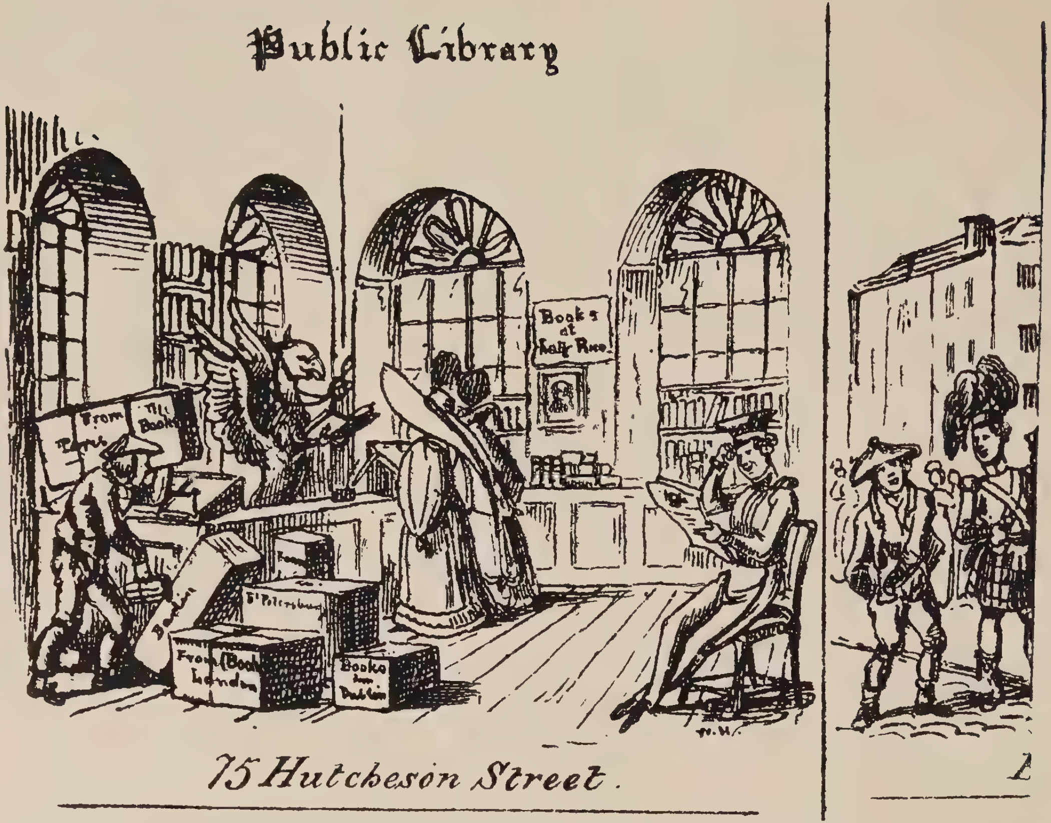
when the Battle of Trafalgar was fought; and we can picture him handing out the news-sheets bearing the tidings of the great but costly victory, and we can imagine the excitement with which those sheets were read in the premises in Nile Street.

John Joseph was trained as a bookseller with Tegg & Co., of Cheapside, London, so that his tendency would naturally be towards the "Remainder" Trade and Book-Auctioneering. He also studied on the Continent at Paris and Heidelberg, and chemistry was his special subject, for which he appears to have had a natural aptitude. It looks, on the face of it, as if the elder son were intended for the original part of the business, while the younger, being intended for the new venture—and, possibly in the father's view, less important part—was sent to London to be fully trained as a bookseller in order that he might develop the Branch. But in that case, as very often happens, the natural tendency decided against the formal intention; and the elder son had a natural bent for the side which perhaps was intended for his younger brother. Richard Thomas married Mary Eaves, and John Joseph married Mary A. Holder. Neither of these names is Scottish; and one of them is especially to be noted, as it will appear again in the person of her granddaughter, who managed the business of the Firm in days when it fell to her to relieve her mother in the work of preserving the business as a property for the family.

We can picture the energetic Richard Thomas Griffin attending to the business in the second decade of the nineteenth century, from the time when he was twenty years of age until he was thirty. Scott was writing his Waverley novels in that decade; Brougham was in Parliament, and building up his brilliant reputation; Byron was writing *The Bride of Abydos*, the *Prisoner of Chillon*, *Childe Harold*, and many others of his magnificent poems; Wordsworth was writing *The Excursion*, *The White Doe of Rylstone*, *Peter Bell*, and *The Waggoner;* Sydney Smith had already built up his reputation as a wit, and was even then a pungent, though perhaps not a great, literary critic; and other makers of English literature were supplying the books which the House of Griffin was distributing to the citizens of Glasgow. It was a time of intense activity; and Glasgow, which Defoe, in 1723, had described as "the beautifullest little city I have seen in Britain," was parting with its littleness, if not with its beauty, and was throwing itself heartily into all the activity of the country.

By the end of the decade the Firm is "Richard Griffin & Co.," and Joseph's name has disappeared. I take it that the father had died before this time. And in the last year of that decade, 1820, the House published its first volume, and adopted its book-plate or Trade Mark. The Arms of Glasgow are an oak tree proper, with a bird, a fish, and a bell, the motto being "Let Glasgow flourish by the preaching of the Word." Even Glasgow men, who ought to know better, seldom quote the motto fully, nearly always stopping at the word "flourish," as if they meant "let it flourish, if not by the preaching of the Word, then without it." The Arms and Motto have given rise to a bit of doggerel, which runs thus—

"This is the tree that never grew,
This is the bird that never flew,
This is the fish that never swam,
This is the bell that never rang."



ADVERTISEMENT FROM "THE GLASGOW LOOKING GLASS."

To face page 52.]

Of course, there is a legend accounting for the Arms, but it does not enter into our story. The House of Griffin adopted the oak tree as its symbol, with the motto *Quis separabit nos?*

The Glasgow Directory, which was not an annual publication, but was published in July, 1820, has this entry—"Griffin, Rich. & Co., Booksellers and Publishers, 75 Hutcheson Street." The Firm may have been in business a year earlier, but this is the first issue of the Directory in which its name appears.

In the following year, the House of Griffin made another advance by forming the "Griffin Public Library," which was doubtless a circulating and lending library. But the year 1820 cannot be left without noting that it was the year of the accession of King George IV., that it was a year of destitution in Glasgow, with rioting and trouble, and that another member of the Firm was born, Charles, son of Richard Thomas.

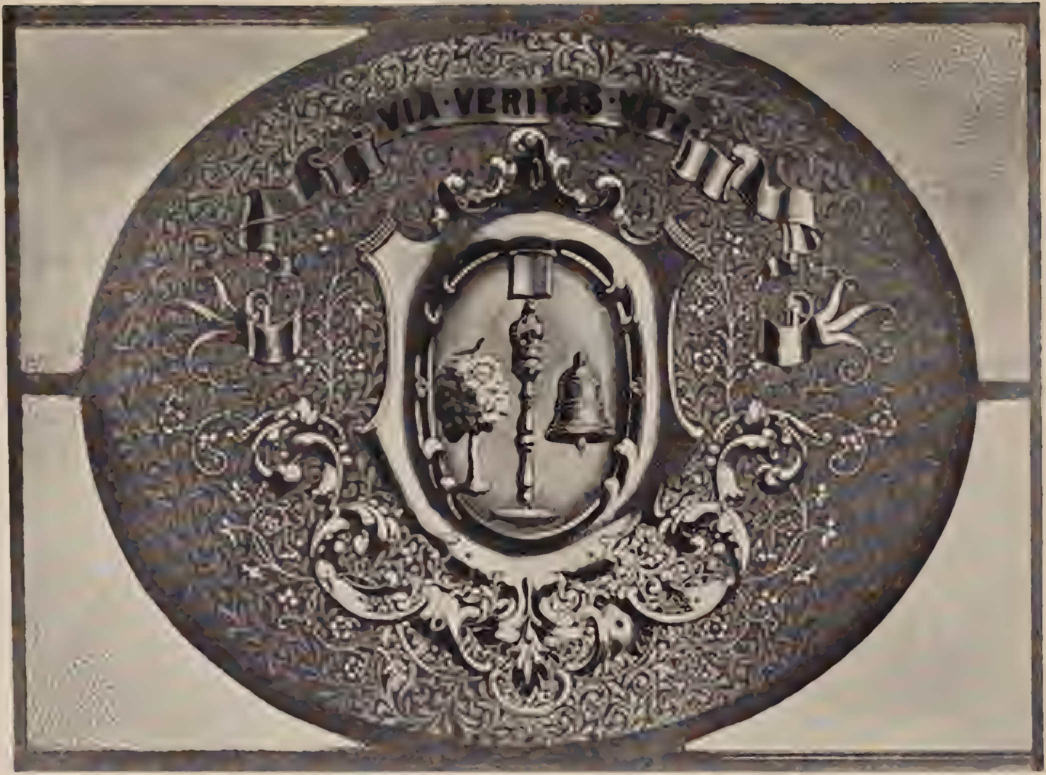
The Glasgow Directory was taken over by the letter-carriers in 1828, and from that time was published annually. In that year the entry of the Firm is—"Griffin, Richard & Co., Booksellers and Publishers, Public Library and Newsroom, 64 Hutcheson Street." In the same issue there is an entry—"Griffin, John, of *Scots Times* newspaper Office. This newspaper was published from 90 Brunswick Street, the street next to Hutcheson Street, but from an entry in the Directory of 1833 it would appear that in that year at any rate Robert Malcolm was the owner.

In the Directory of 1830 there is an entry—"Griffin, Richard, of R. Griffin & Co.," and his address is given as 115 Buchanan Street, but there is no reference to

John Griffin of the *Scots Times*. The Firm's address is also given as 115 Buchanan Street, in this volume.

The association of the name of John Joseph Griffin with the *Scots Times*, whether as owner or as holding an interest in it, indicates the activity of the Firm. There was already a newspaper in Glasgow, founded in 1779 as a weekly with the title of *The Glasgow Advertiser*. In 1782 its name was changed to *The Glasgow Advertiser and Herald*, while a little later it appeared simply as *The Glasgow Herald*, and has continued to the present time, when it is second to none out of London. In the days of which we are treating it was published only on Mondays and Fridays, so there may have been scope for another newspaper without homicidal competition.

Some curious relics of the House of Griffin survive from the early days of its history. There is extant an advertisement of the Firm in *The Glasgow Looking-Glass* of the year 1825, in which a griffin of mythical and heraldic fame is figured serving books in the Library. A stained-glass window which formerly belonged to Griffin's old premises in West Nile Street still exists, having been purchased by Messrs. Edmiston, the Auctioneers, of West Nile Street, when the premises were demolished some years ago. It is placed over the entrance to their principal sale-room, and with their permission, and by the kindness of Mr. Cunningham, of Messrs. Bell & Bain, Ltd., a photograph has been obtained and is shown here. It depicts, perhaps, the best example of the old University coat-of-arms surmounted by the University motto, *Via, veritas, vita*. I remember seeing that window often when I was a boy, and recently, on passing through the city, I took occasion



Stained Glass Window (Glasgow University Arms).

To face page 54.]

to look at it again, and was delighted with its freshness and beauty.

There is also surviving an original handbill of Griffin's Public Library, with a woodcut of the premises at Hutcheson Street, besides which the handbill contains a description of books and a statement of the terms of membership and other particulars (see page 45).

Richard died in 1832, and then John was obliged to devote himself to the complete oversight of the business, as Charles, the son of Richard, was only twelve years of age at the time. John's inclinations appear to have been more on the side of science, and especially of chemical science, than on that of bookselling or book publishing. He devoted great efforts to popularising the study of chemistry, and assisted in the foundation of the Chemical Society in 1841. John Griffin's name as a student of chemistry must have been familiar far beyond Glasgow, and he must have kept up an association with London students of the same tastes as himself, for this Society is one with Headquarters in London, and it is incorporated by Royal Charter which dates from the year 1848. At last, the strength of the inclination was so great that when his nephew, Charles, was grown up and fully able to manage the bookselling and publishing business unaided, John and he dissolved partnership. The nephew, Charles, retained the bookselling and publishing business, and the uncle, John, took the scientific instrument and the chemical business, as separate organisations and Firms. But this was a few years after the Firm had removed to London.

John had published in his early days a translation of Heinrich Rose's *Handbuch der Analytischen Chemie.* He also had a great deal to do with the editing of the

Encyclopædia Metropolitana, which was one of the great and outstanding works of the publishing Firm. He was author of *A Treatise on the Blow-pipe*, *A System of Christallography*, *The Radical Theory in Chemistry*, *Centigrade Testing as Applied to the Arts*, *The Chemical Testing of Wines and Spirits*, and other papers in which he strove to inculcate the necessity of introducing scientific method into commercial processes. With the view of making the study of Chemistry popular he published *Chemical Recreations*. He died in 1878, aged seventy-six years. His scientific and technical bent and knowledge must have had a deciding influence in giving the publishing Firm its determination to devote itself specially to technical works. The existence of the Firm of Charles Griffin & Co. must have been a real asset to the country in those years in which the industry of the country required exactly the help which its publications were intended and fitted to give. Similarly, in the years which are now before us, when the world-losses of the Great War compel intensive work of the highest skill, the realm of publishing which the House of Griffin has made its own must be of a value which is Empire-wide, and even World-wide.

It was in the year 1848 that the Firm resolved to transfer its centre to London, and this was done on the advice of John, the uncle of Charles. But it did not by any means imply a loss of interest in Glasgow or of association with that city. The connection of the House with the University and the city was too close and intimate for that. It is recorded in the *History of Glasgow*, by Coutts, that Charles Griffin, of London, was, on his own application, appointed Publisher to the University; and this appointment was held by himself and his Firm until

Charles Griffin, 1820-1862.
Married Jessie Jane Rae.

Mistress Charles Griffin 1823-1909.
From 1862 administered the business for several years.

about 1871, when the Glasgow Firm of James Maclehose & Sons became Publishers to the University.

The last domicile of the Firm in Glasgow appears to have been in Bothwell Circus, and up till ten or twelve years ago there remained in that locality an old relic of the Firm's Glasgow connection in the shape of a sign-board bearing the legend.

“Charles Griffin & Co.,
Technical Book Publishers.”

ELEMENTS

OF

AGRICULTURAL CHEMISTRY,

IN A

COURSE OF LECTURES

DELIVERED BEFORE THE

BOARD OF AGRICULTURE.

BY

SIR HUMPHRY DAVY, BART.

PRESIDENT OF THE ROYAL SOCIETY.

A NEW EDITION,

WITH

INSTRUCTIONS FOR THE ANALYSIS OF SOILS,

AND COPIOUS NOTES,

EMBRACING THE

RECENT DISCOVERIES IN AGRICULTURAL CHEMISTRY.

BY

JOHN SHIER, A.M.,

FORDYCE LECTURER ON AGRICULTURE, IN THE UNIVERSITY OF ABERDEEN.

GLASGOW:
PUBLISHED BY RICHARD GRIFFIN AND COMPANY
AND THOMAS TEGG, LONDON.

MDCCCXLIV.

Rev. THOMAS HANNAN, M.A.

Chapter III.

GENERAL LITERATURE, EDUCATIONAL AND RELIGIOUS.

By the Rev. THOMAS HANNAN, M.A., Hon. C.F., F.S.A. Scot.

Griffin one of the Earliest of British Publishers—Only Four or Five of earlier Date—Griffin's publish for Public Needs—Development from General Literature to Technical Books—Works of National and World-wide Usefulness—Early Religious Works—Books on Travel and Education—A host of Famous Authors—The Encyclopædia Metropolitana—The Circle of the Sciences—Costly Works richly Illustrated—Charles Griffin and Henry Bohn—Charles Griffin's death, 1862—The Business administered by the Widow and Trustees—Steady and Continuous Growth—Griffin's notable Red-cover Books—Griffin's Outlook To-day.

Chapter III.

GENERAL LITERATURE, EDUCATIONAL AND RELIGIOUS.

IN the realm of publishing, for a House to be able to celebrate a centenary of uninterrupted work may almost be said to be a mark of hoary antiquity. When Charles Griffin & Co., Ltd., claim to celebrate the centenary of the House in 1920, it must be impressed upon the reader that it is a real centenary of actual publishing—not a matter of dating its origin as a publishing Firm from the day when it opened its doors as a bookselling establishment, merely acting as a distributing agent for the books which some Firm long defunct actually issued. The imprint of the House as publishers is found with the date 1820, and the name of Griffin has been the name of the Firm from that date.

The Art of Printing is only four centuries old in the Western world, and to have an age of one-fourth of that period is something worth remembering. The oldest publishing Firm in the country is the Cambridge University Press, which originated in the sixteenth century. But when we come to private ventures, or commercial publication, we do not find any very great antiquity. If Rivington's existed in the present day as a Firm, it would probably have the highest claim to be the oldest publishing House in Britain, for its origin is generally given as 1711.

But it was amalgamated with another great and old Firm in 1890. That Firm is Longman's, which began in 1724, when Thomas Longman, the first of the name, bought the stock and business of William Taylor, deceased, in Paternoster Row, at the sign of "The Ship and Black Swan." The Firm has the unique distinction of having carried on its business at the same address without interruption for nearly two hundred years, though with very many partners. According to another account which I have consulted, Thomas Longman was a native of Bristol, who was apprenticed at the age of seventeen to the well-known London publisher, John Osborne. He became his partner in 1724, and, on Osborne's death, succeeded to the business. Probably the two accounts are in some way complementary; but in any case the date is agreed upon, and there is no doubt that the founder was the first of five Longmans in the Firm who bore the name of Thomas.

The Firm of John Murray, Albemarle Street, dates from 1768, when it was founded by a hardy Scot named John MacMurray on his retirement from the Royal Marines on half pay.

William Blackwood & Sons, of Edinburgh and London, was founded in 1807 by William Blackwood. The history of that Firm is interesting. William Blackwood was apprenticed to Bell & Bradfute, publishers, of Edinburgh, in 1790, at the age of fourteen years. On the conclusion of his apprenticeship he went to Glasgow as Manager of a Branch for the large Edinburgh publishers, Mundall. He left there for London, but not long afterwards was back in Edinburgh in business for himself as a bookseller on the South Bridge. He became agent for John Murray,

THE HIGH-METTLED RACER

By
Charles Dibdin

Illustrated
by

PUBLISHED BY

RICHARD GRIFFIN & Cº, LONDON & GLASGOW.
1856.

but began publishing for himself in 1807, his first important book being M'Crie's "Life of John Knox," published in 1812.

Next in order of time, so far as I can make out with certainty, was the Firm of A. & C. Black, with date 1815. But the well-known and enterprising House of Thomas Nelson & Sons was established in 1804 by Thomas Nelson, in a curious old house in the West Bow of Edinburgh. The Firm made a speciality of selling cheap popular books; but whether the Firm published them, or merely sold them as a bookseller, I have not learned. The Firm's distinguishing line is worth noting, seeing that the House is to-day the leader in cheap reprints of books which nearly everyone wants.

The familiar Firm of Blackie & Son may probably be dated from the year 1809, when John Blackie took over the business of W. D. & A. Brownlie, of Glasgow, in which he had been an assistant. Others were associated with him, and ultimately there was a division of the business, from which was evolved the actual publishing Firm of Blackie & Son as we know it.

I have placed the last two out of the chronological order in which they would appear according to the dates quoted, because I am uncertain as to whether the actual publishing was made a feature of the businesses as early as those dates, or whether the dates mark the rise of the businesses as bookselling Firms only. But there is no hesitation in placing in order of age the Firms of Longmans, John Murray, William Blackwood & Sons, and A. & C. Black, the last of which, as already stated, began in 1815.

In the order of age, it is quite clear that the Firm of Charles Griffin & Co. ought to be placed after A. & C.

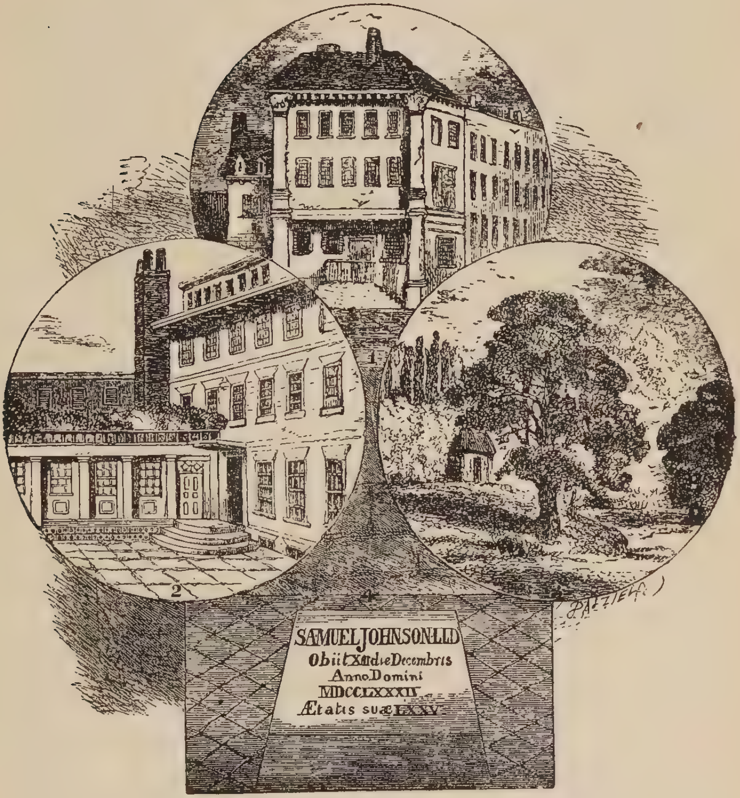
THE LIFE

OF

SAMUEL JOHNSON, LL.D.

BY

JAMES BOSWELL.



1. Birthplace of Johnson
2. Bolt Court
3. Summer House, Thrale Place
4. Tomb of Dr Johnson

LONDON
CHARLES GRIFFIN AND COMPANY,
STATIONERS' HALL COURT.

Black, with the possibility that Thomas Nelson & Sons and Blackie & Son have a claim to be placed in a similar position. These three Firms come so close together in the time of their origin as publishers that there need not be any very great distinction among them.

No Firm can continue long as publishers unless it meets, and continues to meet, a public taste and public requirements. Public taste changes from generation to generation, and the Firm which has acquired position by meeting a taste but omits to observe the change as time goes on finds ultimately that a new Firm has caught the tone of the time and is marching to success, while the old Firm decays, and, perhaps, ceases to exist. That the House of Griffin has continued to exist for a hundred years is a testimony to its real success as an organisation. It has not set itself to meet the changing tastes, or it might have established for itself a name as a great publisher of fiction. Some of the modern houses are publishers of practically nothing but fiction. The House of Griffin has developed its system to provide not so much for a varying public taste as for public requirements. Public requirements change, of course, as well as public tastes. But they do not change suddenly or arbitrarily: they develop. They require keen watchfulness; and it is that quality which has enabled the House of Griffin to keep abreast of the solid requirements and the immediate needs of the country in publications of an educational and general character.

I turn to the Calendar of the Royal Technical College, Glasgow, which is quite equal to the much vaunted German Technical University at Charlottenburg, and has not only a magnificent building, but a magnificent organisation, and I find on the first page the advertisement of the Firm of Charles Griffin & Co. The Calendar is that for 1916-17, which I had for the purpose of writing an article to show that the British system of Technical Instruction is not only as good as the German, but better than it, and I have kept the publication by me. The publications advertised are under the headings of Mathematics, Chemistry, Metallurgy, Engineering, Mining, Geology, Naval Architecture, and Textile Manufacture. These are all headings which appeal to the College, for it has classes in these subjects among many others. Under the heading of Chemistry there are thirteen publications on different branches. Under Metallurgy there are also thirteen publications. Under Engineering there are ten publications. The comprehensiveness of the lists may be gathered from a repetition of the subjects under Engineering—" Manual of Civil Engineering Practice," " Main Drainage of Towns," " Dock Engineering," " Harbour Engineering," " Mechanical Drawing," " Steam and Steam Engines," " Land and Marine Diesel Engines," " Internal Combustion Engine," " Marine Engineering," and " Electrical Photometry." These lists form the appeal which the Firm of Charles Griffin & Co. makes to the city in which it had its origin as a publishing Firm one hundred years ago.

The lists indicate the lines on which the Firm developed in its aim of supplying the requirements of the country. They are not the lines on which a Firm might expect to attain a magical popularity on the crest of a wave of enthusiasm for an exciting book. To take one of Griffin's excellent treatises purely as an example of the point; I cannot imagine the Circulating Libraries being besieged by anxious inquirers with the question, " When can you let me have Butler's " Internal Combustion Engine?" and returning the answer, " I am afraid we can only put your name down for it, and you shall have it in your turn as soon as possible; everybody is asking for it." These glories are reserved for sensational fiction—which I admit that I often read—and for books about highly-placed personages, princesses or duchesses preferred, against whom the tongue of scandal has wagged.

Considering the matter philosophically, I feel that the beneficent, utilitarian, and well-regulated beauties of an internal combustion engine should evoke as widespread and engrossing human interest as the maleficent, useless, and ill-regulated beauties of a semi-oriental Court. But they do not. There is, however, a kind of solid popularity attending the successful provision of works of national and world-wide usefulness. It does not come suddenly, but has to be built up by steady and unvarying attention to the things that make for the good of the world; and Charles Griffin & Co. have attained that solid form of popularity by a continuous series of technical publications which cannot be rivalled by any other Firm.

The value of a centenary of such usefulness will be seen if we first note the very small number of existing Firms with seniority over the House of Griffin, as recorded above, and then note the names of some of the publishing Firms of front rank in the present day which are junior to Charles Griffin & Co.

Smith, Elder & Co. only dates from 1842, and has recently been absorbed by John Murray. Macmillan & Co. was begun in 1843 by two Scotsmen from Ayrshire. Frederick Warne & Co. dates from 1865. Cassell & Co.

began in 1859 as a publishing house, having been founded by John Cassell, a Manchester man whose trade was that of a carpenter, but whose bent was towards literature and temperance lecturing. Chatto & Windus was begun in 1853 by John Camden Hotten, who struck out the line of introducing American writers to the British reading public—Artemus Ward, J. Russell Lowell, Oliver Wendell Holmes, Walt Whitman, Bret Harte, Mark Twain, and others. Sampson, Low, Marston, Son & Co. may be dated from 1856. The House of George Allen & Son was founded in 1871; that of Edward Arnold in 1890; J. M. Dent & Co. in 1872; Hutchinson & Co. in 1889; T. Fisher Unwin in 1882. William Heinemann only began in 1890; while Methuen & Co. began in the eighties, with a development in 1894. Yet this is not an exhaustive list of those firms which are junior to Charles Griffin & Co. None of them seems to have entered into competition with the Firm which has been called "The Makers of Modern Technology;" and that indicates how completely the House of Griffin has occupied and cultivated its field.

If we hark back to the earlier days of the Firm there is an immense amount of interesting matter in connection with their publications and their authors.

I find among the subjects an Essay by Foster on Doddridge's "Rise and Progress of Religion in the Soul," published at Glasgow in 1839, at the price of 4s. Devotional books were popular with the good people of Glasgow in those days; although possibly the publication was specially directed to the Divinity students of the University. But few of the general public now know who Doddridge was, and fewer still know who Foster was. Philip Doddridge was a famous Nonconformist minister of the days immediately succeeding the Puritan disputes, a man of the greatest piety, who wrote many devotional books, and had a great influence as a preacher. He is also famous, among those who know, as having been advised by Edmund Calamy, the younger, not to seek the ministry. Doddridge's works made a strong appeal to Scottish Presbyterian sentiment. Foster was John Foster, a Baptist preacher of Yorkshire, who was also an essayist. He died in 1843.

In the following year I find that the Firm published an Essay by J. P. Smith, who has not come down to fame, on the "Revival of Religion in New England," a work by the famous American divine, Jonathan Edwards. Edwards died in 1758, so that his style and teaching were on much the same plane as those of Doddridge. Another essayist, named Young, introduced the same author's "Treatise on the Religious Affections" in 1847. The same essayist treated of "Halyburton's Memoirs" in 1839, in an introduction to that work published by Griffin. Thomas Halyburton was a famous Scottish theologian, who published his "Memoirs" in 1710, when he was Professor of Divinity at the University of St. Andrews. Then I find that Griffin published Butler's "Analogy," by Wilson, in 1846, and D'Aubigné's "History of the Reformation," by Beveridge, in the same year. Apparently the Firm, with that system which has always characterised it, was making an effort to place the leading theology of the preceding century before the public.

An early book of the Glasgow publishing period is by a very remarkable man, the title being "Mother's Book," and the author James Montgomery. This was published in 1832, and I find that exactly thirty years later the Firm in London published another of Montgomery's works. But Montgomery was dead before that year, 1862. When Montgomery published "Mother's Book" he was resident in England, and must have been in touch with many publishers, so that his publishing in Glasgow indicates that Griffin had a good standing as a publisher at that early date. Montgomery was born in 1771 and died in 1854. He was a native of Irvine, in Ayrshire, but went to England and joined the staff of the *Sheffield Register* in 1792, becoming Editor and Proprietor in 1795, when it was renamed the *Sheffield Iris*. He seems to have been for the time a rather violent politician, as he suffered fine and imprisonment for seditious utterances. But he wrote poetry of a religious order, and the book which Griffin published in 1862, after his death, was "The Christian Psalmist: Hymns Selected and Original." It was the tenth edition, so I cannot tell in what year Griffin published the first edition. Few people who sing the Hymns "For ever with the Lord" and "Songs of Praise the Angels Sang" know anything about the writer of those beautiful hymns; but this Montgomery was the man.

In 1835 Griffin published another of the theological works of the divines of the preceding century in the shape of Thomas Boston's "Human Nature in its Fourfold State." Boston was in many ways a curious product of his day, and a most eminent man in Scotland. This particular work had exercised a powerful influence on religious life in Scotland, and no doubt it was still in demand when Griffin published it. He was minister of Ettrick, in Peeblesshire, to which he was appointed in 1707. Doubtless he considered himself a man of peace, but he was always in the middle of strife. He was a constant protester of the rights of congregations to choose their ministers, and thus was on the side of the Patronage controversy which produced the Free Church more than a hundred years after his death; he refused to take the abjuration oath in any form; he opposed Professor Simson, of Glasgow, for alleged unsound doctrine; and he was right in the middle of "the Marrow Controversy," which agitated Scotland for years. To talk about "the Marrow Controversy" now is to speak the dead languages. It arose over a Puritan work, "The Marrow of Modern Divinity," originally published in 1646, which Boston reprinted in 1718. The General Assembly of the Church of Scotland condemned it in 1720; but Scottish theologians never have accepted condemnation tamely, and the controversy went merrily on until everyone who was interested in it was dead.

Another of their early works was a book of travel, "Summer and Winter in the Pyrenees," by H. C. Ellis, published in 1841, first in an edition at 9s. and again, in the same year, in another edition at 2s. From 1838 until 1862 Griffin continued to publish works by this author until there was quite a long list—"Women of England," 1838; "Daughters of England," 1842; "Mothers of England," the same year; "Wives of England" and "Family Secrets," 1843; "Temper and Temperament," 1846; "Fireside Tales for the Young," 1849, a work in four volumes, costing 20s.; "Hearts and Homes, or Social Distinctions," 1849, three volumes at 37s. 6d., republished in an edition at 7s. 6d. in 1856; "Prevention Better than Cure," 1853; and "Fairy Tales from the North," 1862.

A "Treatise on the Calculus of Functions," published in 1847, is an indication of the early beginning of educational works. That treatise was by a man whose name ought to be known, Augustus de Morgan, who was Professor of Mathematics in University College, London, at the date of its publication. He contended vigorously for the union of Mathematics and Logic. But what is more notable is that he prepared a Report in favour of decimal coinage, which was recommended by a Committee of the House of Commons ; and we have not yet got a system of decimal coinage, so tenacious are we of old usage.

These are only a few examples of the industry of the Firm in the years between the beginning of its publishing enterprise and the transfer of the business to London.

These years were mostly years of the management of John Joseph Griffin, as his nephew, Charles, was only born in 1820, and Charles's father, Richard Thomas, died in 1832, when the boy was only 12 years of age. Doubtless, according to the custom in Glasgow, Charles began his business life at about the age of 16 years, so that when the change to London took place in 1848 he was 28 years of age, and a man of business experience and ability. The judgment of the uncle and nephew was justified, and from 1848 there was a continuous development of the business, and volumes of many types issued from the House.

In the year of the removal to London, whether before or after is not clear, a striking work was published in "Selections from the Poetical Works of William Cobbett." This was in six volumes, octavo, at the price of 50s., and was, I think, the first of Cobbett's works that the House of Griffin published. In later years the Firm published his "Advice to Young Men and Women" (1861), "Cottage Economy" (undated), "The English Gardener" (undated), and "The Poor Man's Friend" (undated).

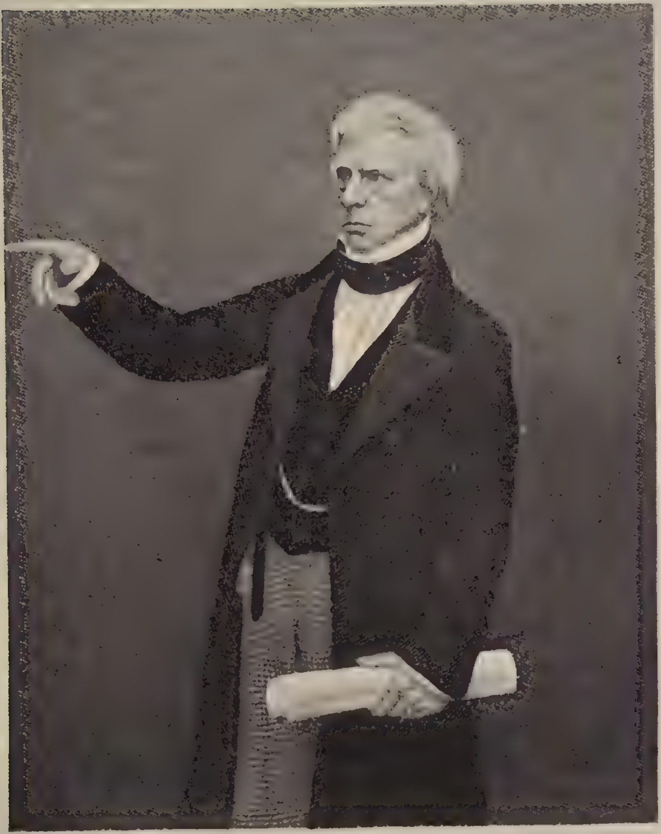
Cobbett was one of the outstanding men of his generation. He was born at Farnham, Surrey, in 1762, and died on June 18th, 1835, after speaking in the House of Commons on the Marquis of Chandos's motion on agricultural distress. Cobbett went to London at the age of 21, and became a solicitor's clerk. This was too quiet a calling for him, and he joined the Army as a private. He obtained his discharge in 1791, after service in Nova Scotia. He next went to France, and from there he went to the United States in 1792, and opened a bookseller's shop in Philadelphia. He soon started out as proprietor and editor of a newspaper. *Peter Porcupine's Gazette;* but the porcupine's quills pricked the owner, as his leading articles brought a lawsuit against him, with damages of 5,000 dollars. So he returned to London in 1801, and published the "Works of Peter Porcupine" in twelve volumes. He started another newspaper, which he called the *Porcupine*, but it failed. He made a successful venture, however, in the *Weekly Political Register*, which continued till his death. He got into trouble over some comments on a military flogging, and was sentenced to two years' imprisonment and a fine of £1,000. After contesting elections for Coventry, Preston, and Manchester, he was at length elected for Oldham in the Reform Parliament. Hazlitt's opinion of him as a writer was that he "might be said to have the cleverness of Swift, the naturalness of Defoe, and the picturesque satirical description of Mandeville." Coleridge said of him that "he had lifted the latch of every cottage, and thundered with no run-away knock at the palace gate." Two facts, in addition to his general history as an agitator and a reformer, give something of a key to his nature and character—he championed the cause of the persecuted Queen Caroline, and he brought to England the bones of Tom Paine from America.

Another famous man, whose association with the publishing House of Griffin may be said to have been life-long, was Lord Brougham. The House published his "Natural Theology," in two volumes, at the price of 18s. as early as the year 1828; and between that year and 1857 the same work was published in three volumes, octavo, at 7s. 6d., and in one volume at 3s. In 1855 the House published his "Contributions to the Edinburgh Review," in three volumes, octavo, at the price of 36s., following on their publication in 1853—as a new edition, so they must have published a previous edition—of his "Dialogues on Instinct and Animal Mechanics." In 1859 they published his "Statesmen of George III.," in three volumes, royal octavo, price 21s. each; in eight volumes, 10s. 6d. each; and in three volumes, 10s. 6d. each. In 1860 they published his "Tracts, Mathematical and Physical," a second edition, post octavo, price 7s. 6d. I have not the date of the first edition, but probably it was the previous year. In 1861 they published his "History of England under the House of Lancaster," a new edition, octavo, at 10s. 6d. And from 1857 till 1860 they were continuously publishing a new edition of his works, post octavo, price 5s. each volume, the whole edition running to eleven volumes. But this does not exhaust the list of his works which they published.

I should like to draw attention to one outstanding fact which emerges from most of the personalities which I have described in connection with the publication of their works by the House of Griffin. Whether they were orthodox or heterodox, advanced politicians and agitators or those content with things as they were, they were what will best be described as uncommon men. That circumstance gives us some conception of the personality behind the House. He must have had an instinct for publishing, and he must have had a sympathy with open expression of opinion. Was it the uncle, John Joseph, younger son of the founder of the Firm, or was it the nephew, Charles, grandson of the founder? Or was it the combined sense of the man who had been specially trained to the work although he preferred another form of intellectual activity, and of the young man who, so to speak, had the instinct in his blood as well as the training of his uncle? I am inclined to think that it was mainly the nephew.

I think that this conclusion is borne out by the friendship which existed between Lord Brougham and Charles. Charles Lamb once proposed as a toast a man whom none of the audience had ever known. Someone asked what meritorious deed he had ever done, and Charles replied, "He sh-sh-shot a p-p-publisher." In spite of Charles Lamb, there have been many cases of real friendship between an author and his publisher; and this is one of them. Charles Griffin, who married Jessie Jane Rae, was the father of eleven children, of whom the eighth was Henry Brougham Griffin, Lord Brougham being his godfather.

Lord Brougham's career was one of remarkable



Brougham

THE RT. HON. HENRY LORD BROUGHAM, LL.D., F.R.S.

brilliance and almost equally remarkable disappointment. He was born in Edinburgh in 1778, and was admitted to the Scottish Bar in 1800. He was not a pronounced success at the Scottish Bar, for his characteristics were not those of a "canny Scot." He was violent in his opinions, impulsive in his actions, and rash in the expression of his opinions. In 1805 he went to London, and was called to the English Bar in 1808. In 1802 he had joined with Jeffreys and others in founding the *Edinburgh Review*, to the first twenty numbers of which he contributed eighty articles. The phenomenally wide scope of his learning is indicated in the list already noted of the works which Griffin & Co. published.

At the English Bar he made a great reputation, and his next step was to enter Parliament, which he did in 1810. He was a great champion of popular rights and of the cause of the oppressed; and his defence of Queen Caroline in the Divorce proceedings which George IV. brought against her in 1820 made Brougham a national hero. In 1830 he was made Lord Chancellor, and did much to facilitate the passing of the Reform Bill. But when the Ministry was reconstructed in 1834 he was omitted, and although he lived till 1868, when he died at the age of ninety years, the year 1834 marked the end of his political career. And the reason was simple—although perhaps the most brilliant man of his day in Britain, he could not work with others, especially in a Government Cabinet.

Brougham's association with education was long and intimate. He was one of the founders of the University of London in 1825, and of the Society for the Diffusion of Useful Knowledge in 1827. A later movement which he supported strongly was the Social Science Association, founded in 1857. He was at various times President of University College, Lord Rector of Glasgow University, and Chancellor of Edinburgh University. He was a strong advocate of technical education, and this fact, together with the personal friendship which subsisted between himself and his publisher, was an undoubted influence in directing Charles Griffin & Co. towards specialisation in technical publications.

Another remarkable man, among those whose books the House published, was the Rev. John Eadie, D.D., LL.D. The Firm published his "Early Oriental History" in 1851, post octavo, 8s. In 1855 they published his "Commentary on the Epistle to the Colossians," post octavo, 10s. 6d., and his "Discourses on Divine Love," price 5s. In 1858 they published his "Commentary on the Epistle to the Philippians," uniform with that to the Colossians, price 10s. 6d., and his "Ecclesiastical History from the Birth of Christ," by various authors, three volumes, crown octavo, price 21s. Later works were his "Biblical Cyclopædia," his "Classified Bible," his "Epistle to the Ephesians," price 14s., his "Concordance to the Holy Scriptures," by Cruden, a twenty-second edition, the "Dictionary of the Holy Bible," and "Paul the Preacher." Dr. Eadie was born at Alva in Stirlingshire in 1810, and became a minister in Glasgow of the United Secession Church, which afterwards, by its union with the Relief Church, became the United Presbyterian—commonly known as the "U.P." Kirk, which, in turn, united a few years ago with the Free Church to form the United Free Church, the "U.F." Kirk. These ecclesiastical divisions in Scotland are puzzling even to a Scotsman, but there

REV. PROF. JOHN EADIE, D.D., LL.D.,
Author of
"A Biblical Cyclopædia," "The Classified Bible," "Cruden's Concordance (Abridged)," Etc.

is quite a lot more of them, fortunately now become matters of history. Dr. Eadie was minister of a church in Cambridge Street, which removed west to the district of Lansdowne, where the congregation built a very fine edifice, in appearance more like an Anglican Church than Presbyterian. I know its exterior well, but I have never been inside it, and, as a boy, I remember hearing it spoken of in the Scottish fashion as "Dr. Eadie's Church." He was also Professor of Biblical Literature in the United Secession Divinity Hall at Glasgow from the year 1843 until his death, in 1876.

One of the greatest triumphs of the Firm at this early period was their revised edition of the "Encyclopædia Metropolitana." Many encyclopædias had been published, most of which had departed from the original plan of an Encyclopædia. Griffin's publication restored the main idea, with a modification suggested by Coleridge, dividing the whole into four main sections. It was completed in 1845, in twenty-five volumes, but there were many reprints. Among the contributors were Dr. Lardner, F.R.S.; G. B, Airy, F.R.S. and Astronomer Royal; Sir William Herschel, F.R.S.; and Professor Rankine, LL.D., F.R.S., Professor of Mechanics and Civil Engineering in the University of Glasgow. In addition to these there were Dr. Arnold, of Rugby, Mr. Justice Pococke, the Bishop of London, Sir T. N. Talfourd, Professor Eadie, and a host of others who were all specialists in some form of learning.

This Encyclopædia, with the amount of space which it was necessary to give to mechanics, engineering, and the sciences which were at that time being made more and more to serve the domains of manufacture and trade, marks a step in the direction of the House to its specialisation in technical works.

In those advancing years, publications were so numerous that it is hardly possible to quote names as fully representative. But the Firm had made a special mark in steel engravings, copper plate, and wood engravings; and the illustrated Bible, published in 1860 at the price of £4 4s., is an excellent example of their work in this line. Editions of Shakespeare were published at 42s., 21s., and at lower prices in 1859 and 1860; and William Traill's "Universal History, Ancient and Modern," published in 1848 in five quarto volumes at £5 5s., and in 1854 in fourteen volumes, post octavo, at £5 10s., is an example of their expensive works.

John Joseph and his nephew, Charles, dissolved partnership in 1852, the uncle retaining the instrument-making and chemical part of the business as a separate Firm; and that Firm is well known now as John J. Griffin & Sons, Ltd., in Kingsway.

From that year, 1852, until his death, in 1862, at a very early age, Charles Griffin was the sole director of the destinies of the publishing House.

Charles Griffin left the business in trust. He had tried a partner in 1861, when the strain of the work was telling on him; but the partner, Henry Bohn, found a greater attraction in the profession of the Law, and he withdrew before the death of Charles Griffin. The widow was left with nine children, and she boldly faced the task of administering the business, aided by the Trustees, until her children grew up one by one and were able to take a hand in it. That lady survived her husband's death 47 years, dying in 1909 at the age of 86 years, and surviving by ten years a daughter, Elizabeth Eaves Griffin, who developed remarkable ability in managing the publishing business, assisted by her brothers, Richard Thomas and Henry Brougham, and later by Charles James.

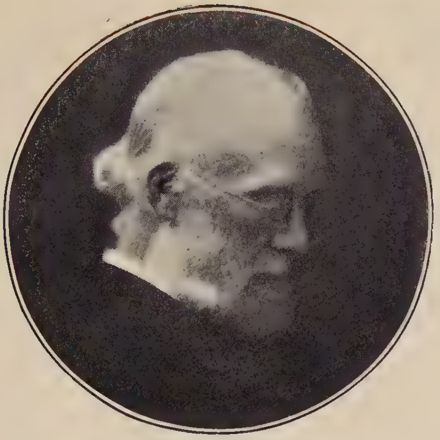
I have still in my working library a few of my old school and University books which were published by the House of Griffin. Among them are Professor Ramsay's "Manual of Roman Antiquities," Currie's "Horatii Opera"—which I used to take to bed with me, I liked it so much—Ramsay's "Manual of Latin Prosody," and one or two others. These were published from 10 Stationers' Hall Court, and I have written my own date on them, 1881. The advertisement pages of the "Roman Antiquities" are interesting to look into now, with Professor Eadie's works advertised in full; Matthew Henry's "Commentary on the Bible," in three volumes, at 50s.; "The Circle of the Sciences: a Series of Popular Treatises;" "Scientific Manuals," by W. J. Macquorn Rankine;" the "Virgilii Opera" of Dr. Bryce, the father of Lord Bryce of the present day; and a host of others which bring back memories.

I look up a catalogue of the present day, and I find that Currie and Bryce on "Horace" are still going strong as school editions. Craik's "Manual of English Literature," first published in 1862, is also well to the fore, with an additional section by Sir Henry Craik, M.P., for the Scottish Universities. The "Roman Antiquities" are also full of life. Professor Eadie's works have not grown old. And while many of the works noticed earlier in this chapter have survived the lapse of time, a number of others, equally early, but not mentioned in this chapter, also still go on.

The distinctiveness of the House of Griffin extends even to the colour of its book-covers; and very often the booksellers of Glasgow have to answer the question of their patrons—"What is the latest in Griffin's Red-cover Books?" The special colour thus associated with Griffin's was arrived at after many experiments, and it is known over the whole world. During the War it was almost impossible to obtain the exact shade of colour which had become so well known; but now that Peace prevails and that there is a prospect of something approaching the normal in the World's affairs, "Griffin's Red-cover Books" will be as distinctive in colour as in former days, while their distinctiveness in contents remains unaltered.

Time, of course, has made changes. Useful books have dropped out of the publishers' list; and members of the Firm, having lived their lives of usefulness and run their course, have handed on their work to others, and, like their authors, have dropped out of the list of the workers of the Earth. When this happens it is in the usual course of events; and regrets, though sincere, are very properly transient. But when one is called away at what seems only the beginning of a useful career, then the regret is poignant. And such is the regret accompanying the death in action of a young member of the Firm, Horace V. Blight, Lieutenant, A.S.C., attached to the Royal Fusiliers, son of the Chairman and Managing Director of the House of Griffin, and himself a Director and Secretary of the Firm.

The House of Griffin has some of the gains of age, but none of the signs which are usually associated with *old* age. It has a century of uninterrupted and successful work behind it, directed along channels not one of which has been contrary to spiritual, moral, and material good, but all of which have made for improvement in these three directions. The Directors of the present day, if they looked through a complete list of all the books which the Firm has published in its century of work, would not have reason to say of any one of them—"It is a pity that we published that book." On the other hand, the list is full of works of which the Directors have the best reason to say—"That book did good work in its day and generation, and we rejoice to have been its publishers." And the Firm looks out on the World with as clear and watchful an eye as ever, youthful in its energy, its enterprise, and its enthusiasm, foreseeing the needs of the period of reconstruction upon which Industry is entering, and ready to provide industry in the future with the technical knowledge which the Firm has been so successful in the past in making its own special province. As "Makers of Modern Technology" their history has been written in Chapter I.



WILLIAM GARNETT, M.A., D.C.L.

Chapter IV.

GRIFFIN'S PUBLICATIONS (1820-1920) IN PURE SCIENCE.

By **William Garnett**, M.A., D.C.L., formerly Lecturer on Physics, St. John's College, Camb.; Professor of Math., Phys. and Mech., University College, Nottingham; Principal and Professor of Math., Durham College of Science; Secretary and Educational Adviser to the Technical Education Board; late Educational Adviser to the London County Council.

Oxford and Cambridge Universities and the Advent of Natural Science Teaching—A Fundamental Change in Conditions—Chemical Laboratories—Practical Physics—Griffin's Intimate Relations with the Universities—Close Association with Great Teachers of Natural Science—Poynting and Thomson's Text-book on Physics—J. Newton Friend's Text-book of Inorganic Chemistry—Nature Study Books—Notable Epochs of Griffin's Century—A World-wide Reputation—The Official Year-book of the Scientific and Learned Societies of Great Britain and Ireland—Griffin's Centenary co-incident with an important Epoch in National Education in which their books take prominent place.

Chapter IV.

SCIENCE LITERATURE.

IT was the advent of Natural Science as a subject of School and University instruction which enabled the Universities of Oxford and Cambridge, in part at least, to recover the position which Universities held in the middle ages. In those days the Colleges were residential hostels for students who were attracted by the great teachers who settled in the Universities. Gradually the Colleges themselves assumed teaching functions, and the powers granted to them by Queen Elizabeth enabled them eventually to aggregate to themselves the duties of the Universities. It is true that the Regius Professors and some other professors continued to lecture in the name of the Universities, but, with few exceptions, they lectured to audiences which were all but microscopic, and, on more than one occasion in the first half of the nineteenth century University professors proposed that attendance at their lectures should be made compulsory on candidates for honours. This condition of affairs was partly due to the Colleges providing lectureships for their Fellows, and to the great competition between the Colleges for places in the Honours Lists in Classics and Mathematics; and, as long as these were the subjects studied by all the best of the Honours men and nearly all the pass men, nothing happened to check the development of the College system. As recently pointed out by Sir Napier Shaw in his presidential address to the Education Section of the British Association, the system was extravagant. The number of teachers of the subjects most generally studied for University examinations was greatly in excess of the needs of the situation, through the Colleges being, to a great extent, educationally self-contained, and there was little inducement to graduates to take up special lines of research so as to extend the boundaries of knowledge. But there was no pressure upon the Colleges to deal otherwise with their emoluments, and it was better for the Universities that College Fellows should be induced to remain in residence by the offer of College lectureships than that Fellowships should be held by non-residents who contributed nothing to the educational work of the country.

The advent of science changed the fundamental conditions, creating a demand for so large a variety of teachers that the time has now come when we can no longer afford to maintain any teacher whose services are not indispensable under the most economical organisation of the teaching of the Universities and Colleges. When Natural Science began to be taken up by the students of the old Universities the College system tried to adapt itself to the new requirements. Some Colleges started chemical laboratories, with lecturers or readers in chemistry; one or two provided facilities for practical work in physics, but it was soon apparent that the demands of science, both for teaching and research, were far too great for the Colleges to satisfy. An intercollegiate system, under which students of a group of Colleges had access to the laboratory of one member of the group, served as a palliative, and the intercollegiate system spread from Natural Science to the other subjects of study with advantage to all concerned. But the success of the system, as far as Natural Science was concerned, was of short duration. Laboratories costing tens of thousands of pounds were required for chemistry, physics, and the biological subjects, and these, like their forebear, the Astronomical Observatory, could be provided only for the University as a whole, and must be superintended by professors and other teachers appointed by the University. In this way the Universities replaced the Colleges in the teaching of science, and the College laboratories were gradually closed, while the Universities re-entered upon their birthright. To meet the cost to the Universities the revenue of the Colleges had to be taxed, and College Fellowships were made available for University teachers. The system, of course, spread from Natural Science to other subjects of study, and the old Universities are now in reality teaching as well as examining bodies, though there is still room for progress in this direction.

From the dawn of their publishing era Griffin's name has been closely associated with works on Natural Science. Their edition of the "Encyclopædia Metropolitana" contained numerous treatises upon every department of knowledge, and natural philosophy was dealt with by the most eminent men of the age. In these early days there existed intimate relations with Cambridge University, since Griffin's list contained such well-known names as Sir John F. W. Herschel, Bart., Rev. Francis Lunn, M.A., F.R.S., Rev. Hy. Thompson, M.A., and others, whilst Oxford University also figured strongly. The Astronomer-Royal, Sir Geo. B. Airy, M.A., Dr. D. Lardner, F.R.S., Sir John Stoddart, and many others of international fame made contribution to their catalogue. For many years they were the appointed Publishers to the University of Glasgow, and were, in lesser degree, intimate with Edinburgh and Aberdeen. This identification with the leading men of thought and teaching on every branch of philosophy is a characteristic of Griffin's House, though, in recent years, it has been more marked in applied science. That comprehensive series "Orr's Circle of the Sciences" suggests the bifurcation of the way. The last Edition was published by Griffin's in 1861 in nine octavo volumes. Perhaps it was necessarily the last, for the circle of the Sciences can no longer be comprehended in so finite a space, but many of its articles were written by men who were held in very high reputation and are still remembered.

It was said of the Seventh Duke of Devonshire that if he had not been a Duke he would have been Professor of Physics. He was, indeed, second wrangler and first Smith's prizeman. It was he who, as Chancellor of the University, offered to erect and equip a physical laboratory at Cambridge which commemorated the researches of the Honourable Henry Cavendish. The laboratory was designed by the first Cavendish Professor of Physics, James Clerk Maxwell, and among the earliest students whom he attracted to the laboratory were J. J. Thomson and J. H. Poynting, the one, until recently, the holder of the Cavendish Professorship, the other, at the time of his death, Professor of Physics in the University of Birmingham. It is to the combined efforts of these two distinguished physicists, Sir J. J. Thomson, O.M., K.C.B., F.R.S., and Professor J. H. Poynting, Sc.D., F.R.S., that the educational world is indebted for the first four volumes of what may safely be described as the leading modern text-book on physics. The "Properties of Matter," "Sound," "Heat," "Electrostatics and Magnetism" form the subjects of the volumes, which comprise nearly 1,100 pages. We still await the volumes on Electro-dynamics and Light, including those subjects which Sir J. J. Thomson has made peculiarly his own. When these appear it is probable that students will have ready access to material which is not now very easily available, and the leading features of the Theory of Relativity will become understood by all serious students of physics. It is said of Isaac Todhunter that, when he was asked whether he had read the first volume of Thomson and Tait's "Natural Philosophy," he replied that he did not take mathematical periodicals. It is sincerely to be hoped that the completion of that standard treatise will not form a precedent for the monumental work which Messrs. Griffin have in hand.

Another book on Pure Science, unique of its kind, is Professor Poynting's "Mean Density of the Earth." This, too, had its origin in the Cavendish laboratory, where its author, shortly after taking his degree, successfully attempted the bold experiment of weighing in an ordinary balance the attraction exerted by a large sphere of lead upon smaller spheres suspended from the arms. There is reason to think that the name associated with the laboratory afforded the prime motive for the experiment. Here again Messrs. Griffin have associated themselves with Cambridge physics.

It must have required some courage to have embarked upon the venture of publishing the "Text-book of Inorganic Chemistry," in ten very substantial volumes, edited by Dr. J. Newton Friend. Of this book a very high authority says that it is the only work on chemistry in the English tongue which at once is

(1) Thoroughly up-to-date;
(2) Sufficiently comprehensive to serve as a book of reference or dictionary of chemistry; and
(3) Scientifically arranged as a text-book, so that a reader can study continuously some section of the subject, such as "the inert gases" or "the halogens and their allies."

Some of the writers have the advantage of being intimately associated with industry, but all are men of high academic standing. To say more would be to trespass on the province of the reviewer, and reviews would here be out of place.

Science, whether physical or biological, is daily becoming more dependent on mathematical modes of expression, and especially on the methods of classifying and analysing numerous observations. The mathematical theory of statistics was at one time the province of actuaries and economists. It is now of supreme importance to the chemist, the physicist, and the biologist, so that no scientific library is complete without a treatise on this subject. It is gratifying to find that this need has been fully recognised by Messrs. Griffin, and among their publications in pure science is such an authoritative work as the "Theory of Statistics," by J. Udny Yule, M.A., of Cambridge, and Captain Greenwood, the latter of the Lister Institute, evidence in itself of the intimacy between statistics and biology.

Principal E. H. Griffiths, formerly of Cardiff University College, first made his reputation in the world of science by his researches at Cambridge on the measurement of high temperatures, many of which were carried out in conjunction with Professor Callendar. He is the writer of the preface of a work which probably owes its origin to his early researches—" Methods of Measuring Temperature," by Dr. Ezer Griffiths, of the National Physical Laboratory. For many years the observatory at Kew did valuable work in the standardising of mercurial thermometers, and that work is now continued at Teddington, but the National Physical Laboratory has not been content with the range of temperatures possible to the mercurial thermometer, and it is probably within the mark to say that for most of the work which has recently been carried out in this country in connection with the measurement of furnace temperatures we are indebted to Sir Richard Glazebrook and his assistants. Dr. Griffiths' book, therefore, springs from the centre of inspiration,* and the National Laboratory has the great advantage that, while much original work is carried out within its walls, nearly all measuring instruments, wherever designed, sooner or later are applicants for its hall mark. Dr. Griffiths' book deals with the normal scale of temperature, the mercurial thermometer, and the measurement of temperatures by electrical resistance, by thermo-couples, and by radiant energy.

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* Another splendid volume, entitled "The Flow and Measurement of Air and Gases," by Alec B. Eason, M.A. (Camb.) is of great scientific value.

Passing from these standard works of the first magnitude to the other end of the scale afforded by Messrs. Griffin's list, we find the charming books of Eleanor Hughes-Gibb. For children in elementary and other junior schools nothing could be more useful than the "Introduction to Real Life in the Plant World," which is afforded by the little eighteen-penny book "How Plants Live and Work." There is a freshness about the nature study books of Messrs. Griffin's list which brings the breezes of the mountains and the moor into the school-room, and local Education Authorities would do well to introduce some of these books into the daily life of the school. For older children and parents "The Making of a Daisy" provides a study in evolution leading from very humble organisms to the "Daisy Queen"—an example of co-operative sociology at the head of the vegetable kingdom.

The century during which Messrs. Griffin have been known to the world has seen great changes in the education of the country. The year 1820 is famous in educational history as the year of Brougham's first Education Bill, though it was not till thirteen years afterwards that Parliament made its first vote of £20,000 in aid of elementary education, a subsidy which was entrusted to the British and Foreign School Society and the National Society for the Education of the Poor in the Principles of the Established Church throughout England and Wales. The education estimate for England and Wales for the current year, including grants to the Universities, amounts to nearly £33,000,000, and that is exclusive of £6,000,000 entrusted to the Board of Education for the higher training of ex-service officers and men. In addition, it is estimated that the expenditure of Local Education Authorities and other public bodies in education will amount to more than £20,000,000.

While the birth of Charles Griffin & Company coincided with Brougham's Education Bill the Jubilee of the Firm was celebrated by Mr. Forster's Act of 1870, which created the School Boards, and established a national system of elementary education. The years 1902-4 saw the transfer of the local control of education to the County Councils and Municipal Authorities, but, however well the fighting sections of an army may be organised and commanded, they are powerless without a Ministry of Munitions or its equivalent, and to the army of teachers the great educational publishers take the place of that Ministry. If it is the case that, during the early months of the recent war the allied armies were to a great extent paralysed through lack of ammunition, there is some reason to believe that the efficiency of the schools is greatly reduced by an insufficient supply of well-chosen books. This is not the fault of the publishers. A much larger portion of the fifty odd millions expended on education should be devoted to the purchase of books. Every school, however elementary, should have its library, and this should be a genuine laboratory for literary and scientific research. No piece of school work is of more value than the teaching of children how to acquire from books the information they want, and no branch of teaching is so much neglected. Sixty years ago school text-books were misused by teachers requiring their pupils to learn them by heart, paragraph by paragraph. In the reaction the teacher came far too much to the fore, and the oral discourse and black-board demonstration deprived the children of all incentive to acquire knowledge for themselves. The limit to the amplitude of the return swing is reached by those teachers who think it their duty to study the child, without interference, while he develops naturally; but without entering on the most modern theories of the education of the teacher by observation of the child, it may fairly be contended that the highest function of the teacher is to enable the child to learn for himself, and for this purpose the school library is essential. In selecting books it must be borne in mind that one function of a school library is to encourage the love of reading—continuous reading of a book from cover to cover—and the library must contain books which children will be unwilling to put down when they have commenced to read them. The other function is to teach the pupils how to use books as sources of information, and for this purpose books of reference should not be arranged in the form of dictionaries or encyclopædias, but a good index or table of contents is essential.

In connection with science there is a great want of books of the former class—books which treat science as a branch of the humanities, and trace the progress of human thought in the biographies of the discoverers of scientific truth or the inventors of scientific appliances. In the interest of those pupils whose main subjects of study are literary or commercial, every school should be provided with an ample collection of books of descriptive science and the history of scientific progress.

The number of books on pure science published by Messrs. Griffin is not large, but they are all the best of their kind. It is in the application of science to industry that Messrs. Griffin have made their world-wide reputation, and stand as champions for quantity as well as quality, and many chapters are necessary to deal with their large and diversified catalogue, which includes the classical treatises of Professor Rankine and many other works which are on the borderland between pure science and technology, but it also includes many for which pure science may put in a claim. Sexton's "Qualitative and Quantitative Analysis" may be regarded from a utilitarian standpoint; "Analytical Chemistry as a Profession for Women" has a vocational savour, but the "Physico-Chemical Tables" of Castell-Evans, the "Genesis and Evolution of the Earth," and the "History of the Earth's Atmosphere," Professor Park's "Text-book of Geology," "Nature Notes for Ocean Voyagers," and a few others may be allowed to swell the list of works on science published by the Firm, while Dr. J. Scott Haldane's "New Physiology" and Major Ainsworth Davis' "Vegetable Morphology and Physiology" are not the monopoly of the medical student.

Perhaps the best index to the breadth of outlook of the Firm is the fact that thirty-six years ago they founded, and have since produced annually, "The Year-book of the Scientific and Learned Societies of Great Britain and Ireland," an absolutely unique work which has proved of vital importance to the Empire. This publication, which gives particulars of 500 Societies, some of merely local and others of Imperial interest, is an evidence of the scientific habit of mind of the Directors of the Firm, for it could hardly be regarded as a commercial proposition, but testifies to the steady purpose of advancing scientific knowledge, which has been a characteristic from the earliest days of their history until now. It must be gratifying to them to know that, in these recent years, national opinion, which they have done so much to shape, is now largely converted to their point of view.

We have seen how the birth and the jubilee of the Publishing House of Griffin were marked by important developments in Public Education. The Centenary bids fair to form an epoch of no less importance in our national history, while the changes for which preparation is now being made should call upon "The Makers of Modern Technology" for services on a much larger scale than has hitherto been demanded. It is true that Mr. Fisher's Act, passed in the autumn of 1918, anticipated the Centenary by more than a year; but while some of the provisions of that Act came into force immediately, and others during 1919, the great scheme of Part-Time Continuation Schools, which will eventually provide education for all young persons up to the age of 18, unless they have obtained special exemption, will not become compulsory until the autumn of 1921. The year 1920 is, however, the great year of preparation on the part of the Local Education Authorities in respect both of the provision of accommodation and of the training of teachers for the new departure. For students in these schools who have already entered upon their life's work, there should be a very great demand for books of the type which Griffin's know so well how to provide.

Professor T. HUDSON BEARE, B.Sc.

Chapter V.

ENGINEERING.

By Professor T. Hudson Beare, B.A., B.Sc., Regius Professor of Engineering and Dean of the Faculty of Science, University of Edinburgh; Member of the Inst. of Civil Engineers, Member of the Inst. of Mechanical Engineers, Deputy Lieutenant of the County of the City of Edinburgh.

Old-time Methods with Young Engineers—Schools of Engineering—Griffin's Pioneer Text-books—Prof. W. Macquorn Rankine of Glasgow—Enterprise and Genius hand in hand—An Epoch-making Treatise—The Fountain-head of Engineering Text-books—Griffin's fine Discrimination of Suitable Authors—Phenomenal Success of Prof. Andrew Jamieson's Manuals—Courage in Outlay of Capital—Fearless Publishing—Keen Judgment of Engineering Needs—Whole Series of Front-rank Books—Gratitude of the Engineering Profession—A Tribute to the present head of the Firm.

Chapter V.

ENGINEERING.

SEVENTY years ago the majority of young engineers started their professional career by becoming pupils or apprentices with a civil engineer or with a firm of mechanical engineers—electrical engineering had still to emerge as a distinct branch of engineering science—as soon as their school training was finished. There were only two or three Institutions of University rank which provided definite courses of instruction for young men who wished to enter the engineering profession, and these courses were attended by a mere handful of students. The natural result of this condition of affairs was that there was a comparatively small demand for anything in the way of high-class technical engineering literature, a class of book expensive to produce on account of the number of illustrations which are required, and the frequent mathematical expressions and equations which must be freely employed if the books are to be of real value to the student.

Then came a somewhat unexpected change in these old-time methods of entering into the engineering profession, almost every University or University College, both in the British Empire and in the United States, instituted schools of engineering, and, in a very few years, it was recognised that such a college course of training was as essential as the course of practical training in the workshop, the office, or the field if a young engineer was to be adequately prepared for his future profession. It is a striking testimony to the skill with which the publishing business of Messrs. Charles Griffin & Co. has been managed that they were the first of the great publishing firms to recognise that a new field of enterprise was open, if an author of the right type could be found to lay the foundations upon which future developments could be based.

The man required was available in Macquorn Rankine, then Professor of Engineering at the University of Glasgow, and to the enterprise of the Exeter Street firm, then located in Glasgow, and to the genius of Rankine, the engineering world owes a debt which can never be repaid. Rankine's four manuals—"Applied Mechanics," 1858; "The Steam Engine," 1859; "Civil Engineering," 1862; "Machinery and Millwork," 1869—are classics. It is hardly an exaggeration to say that nearly all the engineering text-books which have appeared in the last half-century have to a great extent been modelled upon the lines laid down by Rankine, and are based upon principles which he first enunciated.

In the preface to the "Manual of Applied Mechanics," Rankine explicitly stated that the work contained "facts and principles that have been long and widely known, mingled with others, of which some are the results of the labours of recent discoverers, some have been published only in scientific Transactions and periodicals, not generally circulated, or in oral lectures, and some are now published for the first time," in other words, he claimed to

H. ADLARD, Sc.

W. J. Macquorn Rankine

Author of
"A Manual of Applied Mechanics," "A Manual of Civil Engineering,"
"The Steam Engine," Etc.

have made accessible for the first time to engineers matters of vital consequence to the true understanding of the fundamental principles upon which every branch of engineering science is based, and to have also given to the world in this book the results of his own original investigations in various branches of the subject of Applied Mechanics, including such problems as the deducing of the true equations of the action of steam and other vapours against pistons. The manual, in fact, covered such a range of subjects that at the present day at least half a dozen distinct text-books by different authors would be thought necessary for an adequate treatment of the ground covered by Rankine in the 640 pages of his book. The fact that the eighteenth edition of this treatise has been published is an eloquent testimony to the hold that Rankine still retains upon the engineer. Different editors have assisted the publishers to keep the volume up-to-date, but the volume is in all essentials as Rankine left it.

The " Manual of the Steam Engine and other Prime Movers " was the first attempt to present in an English text-book the principles of " thermodynamics ; " the author said in his preface " this is the first systematic treatise on the science which has ever appeared ; " it stamped Rankine as one of the most brilliant original workers in this, perhaps the most important, branch of engineering science, for without the prime mover where would the modern world be? how, in fact, could our complex twentieth century civilisation exist but for the tremendous advances in this sphere of engineering activity which have been made since Rankine laid down the first general principles in this epoch-making treatise.? The student has to-day at his disposal dozens of text-books covering various special fields in the domain of thermodynamics, but again it is safe to say that the fundamental laws enunciated by Rankine remain as he left them ; we have developed and extended them in every direction as fresh original investigations into the laws of matter have made fresh advances possible, but Rankine was the pioneer who pointed out the path we must tread. This manual has now reached its seventeenth edition ; in the later editions sections on the practical design of the gas, oil, and air engine have been added, but here again the development has largely been the practical utilisation of the thermodynamic functions for air expounded by Rankine in Chapter III. of Part III. of this work.

The year 1862 saw the issue of the "Manual of Civil Engineering," a manual which covered every branch of the department of engineering included in what is popularly called civil engineering—means of transport by land, the provision of sanitary services to cities, the provision of harbours, the control of tidal channels and coastal defences against the encroachment of the sea—every one of these branches is now dealt with in its own special text-book, many of them extending to many more pages than Rankine required to expound the principles upon which they have all developed. This manual has had a greater and more continuous demand from the engineering world than any of the other famous manuals of this gifted and brilliant author, a testimony to the soundness of the work and to the genius of the man who could deal in such a masterly manner with the whole range of engineering as it had developed by the middle of the nineteenth century.

The enterprising firm of publishers who undertook the task of presenting Professor Rankine's masterpieces to the world soon realised that the publishers who controlled the issue of edition after edition of these text-books must, if they were to retain the lead which they had established by their early venture, supplement the masterpieces of Rankine by the issue of a carefully thought-out series of text-books suitable for different types of readers with different mental equipment. Those who have controlled the operations of the firm have in turn had one inestimable gift—they knew when they had secured an author who could do his work in such a fashion as to appeal to the particular class of student for whom the book was intended, and they never stinted expense to make such books a success in every way. Not content with their own excellent judgment and the technical advice of assistants attached to their staff, they sought the counsel of engineering professors as to the kind of books needed for students and others, and also as to who were the likely men to write upon a particular line of engineering work in such a way as to command the confidence of the profession. It was in this capacity that I had the good fortune to come into close association with the firm, and for some ten years prior to my removal to Edinburgh rendered them frequent service. It is a pleasure to reflect that I was responsible for bringing into touch with the heads of the firm several men who have since made their mark as authors of text-books which stand in the front rank.

While Rankine's manuals appeal to a wide circle of readers and students, there was a still more numerous band of students for whom Rankine's work was too strong meat. The Exeter Street firm, with that instinct which seemed always to guide them to the selection of the ideal man for a particular job, selected the late Professor A. Jamieson as author of the series of text-books which were required by the students in the evening classes of Technical Institutes then springing up all over the country under the encouragement of the Science and Art Department. The first of Jamieson's text-books was that on "Steam and Steam Engines," which appeared in 1886, and has now reached its seventeenth edition; this was rapidly followed by a more elementary manual on the same subject, by the well-known volume on "Applied Mechanics," now in its tenth edition, and, later on, by the five volumes of the series which dealt with "Applied Mechanics," "Strength of Materials," "Theory of Structures," "Hydraulics," and "Theory of Machines." Jamieson had the gift of presenting, in a form which could be understood by a student who had but a limited knowledge of mathematics, many of the more important principles expounded by Rankine in his manuals, but, necessarily, not in a form which could be understood by the tyro in mathematics. Jamieson's books were, however, not merely compilations; he introduced much original matter, and he always provided the student with plenty of carefully arranged exercises to test his progress in mastering the subject he was studying. Jamieson had for many years taught large classes of students drawn from the ranks of the young engineers for whom he specially catered in his text-books; he knew their wants, he knew their limitations, and, above all, he knew just how to present to them the subject in such a form as would tend to make the pushing pupil desire more knowledge.

In the West of Scotland Technical College many hundreds of young engineers were trained by Jamieson. A considerable proportion of these young men became sea-going engineers, serving on ships which carried the British flag into every quarter of the globe ; how generally it was the case that the Chief engineer of a British steamer was a Glasgow man was brought home to the stay-at-home Britisher by Kipling's verses and stories, and it is interesting, therefore, to remember that the firm of Griffin & Co. were the publishers who provided the engineering text-books upon which so many of these hard-headed sons of Scotland were nurtured—trained by Jamieson, they naturally made free use in their after years of the text-books of their teacher.

Having laid a sound foundation in the sets of manuals to which reference has already been made, the next step was to provide that the workers in each branch of engineering should be provided with high-class text-books, which would deal with the work of the different branches in much greater detail than could be done in the more comprehensive manuals which dealt with the whole range of engineering science.

One important sphere of work common to several different divisions of practical engineering practice is that of the design of structures in iron and steel. The earliest treatise on this work was the masterly manual on "Bridge Construction," written by the late Prof. Claxton Fidler, a volume which has now reached its fourth edition. A reviewer in *The Engineer* aptly summed up the merits of this book in the three words "sound, simple, and full," a strictly accurate summary of the merits of Prof. Fidler's work—a work of reference which is to be found on the bookshelf of every bridge designer, and it has proved one of the most useful text-books the young student has had at his disposal since it first appeared in 1887. The author frankly recognised that we were in need of further experimental investigations on such questions as, for example, the proper working stresses in bridges, and wind pressure on structures, and it is probable that the attention of the many original workers who have devoted their labours to the solution of some of these points was first directed to the matter by reading the chapters in Prof. Fidler's book which touched upon these matters. I have, myself, found this volume one of the best (dealing with British methods of bridge design) to place in the hands of students who expressed a desire to devote their professional career to bridge work.

At a little later date appeared Anglin's "Design of Structures," a book specially written to supply a want—namely, a concise text-book on structural design which would be available for the young engineer whose knowledge of mathematics did not extend beyond what may be called the elementary stages. This class of student not only requires the subject to be treated in such a way that it is free from the complexities of difficult mathematical equations, but he also needs to have a number of fully worked out practical examples as a guide to the usual method in which the practical engineer attacks the everyday problems he has to solve, and the author obtained this latter result by using both analytical and graphical methods of solution, employing the one method, as it were, as a check upon the other. This is another book which has proved as useful to the draughtsman in an engineering drawing-office as it has to the student in the engineering college, since such essentially practical details as punching, drilling, riveting, and all the processes connected with the manufacture of complete structures are adequately dealt with, and separate chapters are devoted to the actual work of erection of bridges and other structures, and to the preparation of the necessary specifications, a branch of the engineer's every-day work often neglected or overlooked in the college training.

The rapid development of the steel skeleton building structure and of the utilisation of steel rolled girders in the erection of all classes of modern workshops and factories made necessary the volume on the "Design of Beams, Girders, and Columns in Machines and Structures," by Mr. W. H. Atherton, another text-book equally serviceable to the student, and to the designing engineer called in by the architect to assist him in the preparation of the designs for this class of building. A complete revolution in the method of building large factories for all classes of industrial operations when carried out upon a large scale has been brought about by the utilisation of the great varieties of rolled steel sections now available, and a quite new sphere of work has been opened to the young engineer who specialises in the design of steel structures. The needs of this class have been specially catered for by Messrs. Griffin in the book just referred to, and the workshop side of the problem has not been neglected, as is testified by Mr. Farnsworth's work on "Constructional Steelwork," a book of particular value to the firms of constructional engineers who lay themselves out to provide for the requirements of the architect engaged in the design of this type of structure.

The set of works I have just alluded to indicate the skilful and thorough way in which the Exeter Street firm scheme out any fresh development in their publishing activities; the general problem is first tackled, and a good sound text-book is provided which deals with the fundamental principles of the branch of engineering to be provided for, then follow a small series of text-books, each tackling some one detail from the point of view of the designer, and, lastly, a work which brings home to the designer the practical problems which have to be solved in the workshop and the factory before his design can be translated from the working drawings and blue prints of the drawing-office into the solid realities of the structure of steel and iron.

Another branch of professional work which touches every sphere of the activity of the engineer is the generation of power for such purposes as the propulsion of ships, the hauling of railway trains, and the pumping of water from mines, and in these days for the aeroplane. It was quite certain that the firm responsible for the issue of Rankine's classic treatise in its original form, and for the numerous fresh editions which have appeared at regular intervals, would early realise the need of securing the services of men foremost in their respective sphere of work as authors for the numerous text-books which would be needed if this branch of engineering activity was to be adequately catered for. Although the subject of marine engineering is dealt with in another chapter, it is so intimately connected with this that, at the risk of duplicating and with apologies to the writer, I feel bound to include a reference. The wisdom of the firm in the choice of the man was again strikingly proved when, in 1883, they published for the first time the

"Manual of Marine Engineering," by A. E. Seaton, a work which has now reached its eighteenth edition—truly a monumental work. I can still recall vividly my own delight when, in my student days, I became the happy possessor of Seaton's manual, with what eagerness I read it, and how fondly I dreamed when I had really mastered it that I was fit to undertake the complete design of a set of engines and boilers for a first-class liner; a book which can inspire a young student with such high hopes must be a masterpiece. It is difficult to suppose that any other manual on marine engineering can have exercised quite the same influence upon the design of engines and boilers for the many thousands of British built steamers which have taken the water since the first appearance of Seaton's book. I do not imagine that any other book has been so frequently consulted, or has so generally lain on the drawing desk at the elbow of the draughtsman as this manual; no matter what detail the designer was concerned with he could always find sound guidance in the pages of this trusty volume; everything was there from the main set of engines and boilers to the smallest and most insignificant auxiliary. Each fresh edition has added to the value of the book, for every new improvement has been adequately treated, and, in the most recent edition, there are incorporated sections dealing with the Diesel and other oil engines. Two other volumes of great value to the marine engineer have appeared from the pen of Mr. Seaton—the well-known "Pocket-Book of Marine Engineering Rules and Tables," in which Mr. Rounthwaite collaborated with him, and "The Screw Propeller." The pocket-book is the best book of this nature which has appeared for the use of the sea-going engineer ; it has the merit of being thoroughly up-to-date in its most recent edition, the fourteenth (1920), and the mass of information which it contains is absolutely reliable, and it is, moreover, presented in the most useful manner to the marine engineer who consults it. The same praise can be bestowed upon the book on the screw propeller, which deals with what is admittedly a most difficult problem. The whole of the marine engineering world—designers, engine and boiler builders, ship owners, and the engineering staffs of our great liners and our countless tramps—all owe a deep debt of gratitude to the technical skill of Mr. Seaton, and to his powers as a clear writer, and not less to the firm of publishers who have undertaken the task of putting on the market these excellent text-books.

The rapid development of the use of the steam turbine for marine purposes has led to the necessity of providing the marine engineer with text-books dealing with the theory of the turbine and with the construction and management of this form of power generator ; this want has been met by the publication, in 1906, of Mr. Jude's "Theory of the Steam Turbine ;" in the words of the late Sir William White, "one of the latest and best books on the subject"—words of high praise, but thoroughly justified. The development of the marine turbine has been almost entirely due to the enterprise and skill of British engineers, and it is, therefore, only natural that British text-books on this subject should be greatly in demand all over the world.

Two other text-books for the engineers and officers of the Royal Navy and the Mercantile Marine are "Engine-Room Practice," by Mr. J. G. Liversidge, and "Sea

Water Distillation," by Mr. Normandy, both invaluable for the purposes for which they were written, and covering subjects of the utmost importance in regard to the efficient control and management of the mass of machinery nowadays installed in every steamer.

The volume on "Boilers: Marine and Land," by Mr. Trail, is a book of entirely different character to these; it is a text-book specially designed for the use of designers, surveyors, and boilermakers, though, of course, valuable to other classes of engineers; it contains an enormous quantity of information arranged in the most convenient form for daily use. All the rules by the controlling authorities—the Board of Trade, Lloyds, etc.—are brought clearly before the designer and the boiler constructor, and, moreover, the author shows how these rules should be applied both in controlling details of design and in supervision of the actual work of construction.

Mention has already been made of the fact that one of the most important branches of power development is that which provides for the hauling of railway trains, or, in other words, the locomotive. In 1899 the needs of the railway engineer were met by the publication of the "Manual of Locomotive Engineering," by Mr. W. F. Pettigrew, which, in its fourth edition, revised throughout, and reset, appears this year. This work was supplemented in 1907 by Mr. Gairns' volume on "Locomotive Compounding and Superheating." These two text-books give the office staff responsible for the work of designing locomotives just the information they want in the most concise and useful form, and to the locomotive builder they are of the utmost value because special attention has been paid to those details upon which the success of the work depends. Year by year the weight of trains to be hauled in main line traffic has been steadily increasing, involving the use of bigger boilers, and the utmost care in so arranging the utilisation of the steam generated by the boiler that the greatest possible horse-power shall be developed from cylinders whose size cannot be increased beyond certain definite limits. When it is remembered that the standard gauge for our railways which we have adopted, the size of tunnels, and the strength of railway bridges, all impose limitations upon the locomotive designer —limitations from which the designer of other prime movers is in general fortunately free—it will be realised how important it is that the locomotive engineer should have at his disposal in the most readily accessible form the very latest information as to the lines upon which development is proceeding. Much of this information, when first made accessible, is given in papers read before one or other of the many Engineering Societies, and it is not always possible to obtain copies of these papers, especially when they appear in the Transactions of foreign societies; a text-book on a subject like this is therefore not merely a convenience to the designer and the student, it is a necessity, but to be of real value it must be kept up-to-date, and, therefore, frequent new editions are required, a somewhat heavy burden upon the publisher, but a task from which Messrs. Griffin have never shrunk in regard to any of their important standard manuals.

Another branch of the development of power is that which depends upon the internal combustion motor: gas and oil engines in all the varied forms in which they have been built have a field peculiarly their own in many departments of engineering activity, and they are formidable rivals in many fields once considered the exclusive province of the steam engine. In this department Messrs. Griffin have taken a lead in providing the young engineer, the designer, and the manufacturer with a fine series of text-books suitable for the needs of each class of reader, from those who are capable of following the most abstruse arguments based on the most recent developments of physical science to those who want their information in a form in which the practical engineer can utilise results without troubling overmuch as to the way in which these results have been obtained by experimental investigation or mathematical deduction. This series was initiated by the late Bryan Donkin's treatise on "Gas, Oil, and Air Engines." Mr. Donkin was a man of somewhat unusual abilities, able to control and manage successfully a large engineering factory engaged in the production of more or less stereotyped machinery, he was at the same time intensely interested in every fresh development in engineering science, both at home and abroad. His linguistic abilities enabled him to keep in close touch with the work which French, Belgian, and German engineers were carrying on: he was the first British engineer to make generally known modern methods of testing steam plants, and to point out how necessary it was to obtain experimental data in these tests which would enable accurate heat balances to be drawn up. It was only natural that such a man would make a success of a book dealing with the many theoretical and practical problems involved in the design and working of various types of internal combustion motors: how much his treatise has been appreciated is attested by the fact that the volume has now reached the fifth edition, much new matter having been incorporated in the later editions.

Later volumes on this branch of engineering have appeared from time to time, as the developments in the application of the internal combustion motor to motor cars, to aeroplane work, and to steamship propulsion have steadily grown. Reference may be made to Mr. W. Poynter Adams' book on "Motor Car Mechanism and Management," Mr. Strickland's volume on "Petrol Motors and Motor Cars," Mr. Butler's treatise on "Carburetters, Vaporisers, and Valves used in Internal Combustion Engines," Prof. Smith's book on "Suction Gas Plants," and to several important translations, the most important of which is the translation of Prof. Supino's work on "Land and Marine Diesel Engines;" this is a well-known standard work on the subject of the Diesel engine, and it has been admirably rendered into English by two good translators.

Turning now to the field of civil engineering, we again find the Exeter Street firm well to the front in the series of first-rate text-books they have issued—not a single branch of the subject has been neglected, while there are one or two quite first-rate text-books dealing with almost the entire field. Of this latter class Mr. Noel Taylor's "Manual of Civil Engineering Practice," specially arranged for the use of municipal and county engineers, is admittedly the most important, and it may be safely said the best. The author claimed that his book was written specially to meet the needs of young engineers who were preparing to occupy such posts as "Municipal Engineers," or "Burgh Engineers," and that the book was to a certain extent supplementary to Prof. Rankine's classic treatise on civil engineering. The municipal engineer of to-day has to take up most responsible and onerous duties in very varied classes of work, such as the construction and maintenance of roads and streets, the design of engineering structures in reinforced concrete, the design of ordinary masonry bridges and river works, main drainage design and construction, the design of sewage disposal works, the planning and construction of works to secure an adequate supply of water for domestic and manufacturing purposes, and the construction and maintenance of street tramways; every one of these departments of municipal activity is adequately treated by the author, who has drawn upon a varied practical experience for the necessary illustrations, and he has thus been enabled to produce a treatise of value to the young engineer and to the municipal engineer in active professional work.

Still dealing with civil engineering, mention must be made of the valuable series of books dealing with Sanitation problems, the drainage of cities, and the destruction of the solid refuse of towns. The earliest volume on main drainage was Mr. Santo Crimp's well-known volume on "Sewage Disposal Works," published in 1890. Naturally this work was mainly concerned with the chemical treatment of sewage, and it was practically the last word on this form of treatment. Mr. Noel Taylor's volume on the "Main Drainage of Towns," published in 1912, brought the subject up to a much more recent date, when the bacterial method of treatment had already begun entirely to supplant the chemical method of purification. The equally important problem of the disposal of the solid refuse of cities was adequately treated in Mr. W. F.

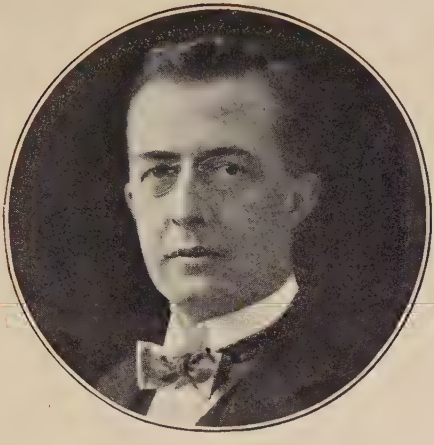
Goodrich's work on "Modern Destructor Practice," published also in 1912, and in Prof. Mathews's volume entitled "Refuse Disposal." The ever-increasing tendency of population to gather into great cities has rendered the work of the engineer, when dealing with the disposal of liquid and solid refuse, of growing importance in connection with public health, and this involves an ever-growing demand for trustworthy text-books on town sanitation problems. Messrs. Griffin have endeavoured to meet this need, and they have been quite remarkably successful in their efforts.

Transport of passengers and goods is another problem which has been rendered increasingly difficult to solve by this modern tendency to create congested population areas, which have to be supplied with their daily bread from sparsely-populated rural areas. There are only two methods by which this problem can be solved, the one is to construct a number of light railways as branch feeders to our great trunk railways, the other is to greatly improve our main road system, and to utilise these roads for motor transport purposes. Both of these new spheres of activity for the engineer have had special text-books from the Exeter Street firm. Light railways have been dealt with by Mr. W. H. Cole in his treatise on "Light Railways at Home and Abroad," which first appeared in 1899, and covers the whole field in a comprehensive manner.

Motor transport can never be put on a satisfactory footing until our whole road system is remodelled, and the method of constructing and maintaining our main roads is radically changed for the better; this is a problem which has been fully dealt with by Mr. Aitken in his treatise on "Road Making and Maintenance," which first appeared in 1900. The first section of this admirable book is devoted to the making and maintenance of what may be called macadamised roads, the second section to the problem of the paving of carriage-ways in cities.

So important is this subject in view of the congested state of railway traffic and the great need of motor transport by road both for goods and passengers, that Messrs. Griffin have just issued a new treatise, "Modern Road Construction," by Francis Wood, in which the whole subject of road engineering is treated after most careful experiments and the closest investigation have been made. The subject, too, of "River and Canal Engineering" has been thoroughly considered and practically dealt with by R. C. Royal Minikin after many years of experience at home and abroad. The author in this book unreservedly places his exceptional knowledge at the disposal of his engineering brethren.

I cannot conclude this short *résumé* of some of the activities of Messrs. Griffin in the work of providing the engineer with text-books in every branch of the profession without expressing on behalf of myself and my brethren of the profession our gratitude for the influence their publications have had in placing engineering practice on a sound scientific basis. Every prominent member of the firm with whom I have had direct personal relations has always made a strong effort to maintain this feature of their publications; they have steadily refused to undertake the work of publishing books of an inferior standard, even when tempting from a merely pecuniary point of view. The present head of the firm, Mr. Francis J. Blight, F.R.S.E., has had the great advantage of being engaged in his earlier days on engineering work, and it has thus always been an easy task to persuade him as to the need of a book on some new development of engineering science, while his intimate knowledge of modern scientific advances in all fields has made him a qualified critic when any new manuscript is offered for publication by an author who has yet to win his spurs. May the firm long continue on the lines upon which they have developed during the century of existence they have already enjoyed, and may they continue to supply the ever-increasing demands made upon their publishing activities by the engineering profession.



Sir W. S. ABELL, K.B.E.

Chapter VI.

NAVAL ARCHITECTURE, SHIPBUILDING, MARINE ENGINEERING, AND NAUTICAL SUBJECTS.

By Sir W. S. Abell, K.B.E., Member of the Institute of Civil Engineers, Member of the Institute of Naval Architects, Chief Ship Surveyor to Lloyd's Register of Shipping, &c.

From the Battle of Trafalgar, 1805, until 1920, the Centenary of Charles Griffin & Co., Ltd.—Progress in the Design and Construction of Ships—"The Wooden Walls of England" give place to Steel—Sails give place to Steam—Marine Engineering—Griffin's Early Publications on Theory and Practice—Wonderful Old Books—Griffin's Nautical Series—The Screw Propeller—The Turbine Compound Marine Engine—Boilers—Marine Diesel Engines—Seaplanes and Aero-Engines—Sir E. J. Reed, Sir J. Harvard Biles, A. E. Seaton, Alexander Jude, Sir Boverton Redwood, Bart.; Captain D. Wilson-Barker, R.D.; C. H. Wordingham, C.B.E., and others.

Chapter VI.

NAVAL ARCHITECTURE, SHIPBUILDING, MARINE ENGINEERING, AND NAUTICAL SUBJECTS.

NEARLY eighteen months have elapsed since the Armistice of November 11th, 1918, terminated the Great War in a naval sense, and such contemplation as has followed must have impressed the student of maritime activities with the remorseless action of seapower, and with the importance which facility of sea communication must play in promoting that international concord which is so essential to the success of the League of Nations.

The present moment seems opportune for a brief review of the progress that has been made in the design and construction of ships and their machinery during the century or so that elapsed between the battle of Trafalgar in 1805 and the battle of Jutland in 1916. It is noteworthy that one of the principal publishers of books on naval architecture and shipbuilding during this period, Charles Griffin & Co., Ltd., celebrate their Centenary this year, 1920.

The annals of naval architecture, though veiled in obscurity in the early ages of mankind, present a record of continuous progress with, however, long intervals, sometimes centuries, of comparative stagnation when the same type of vessel continued with but little modification in design or increase in dimensions.

The history of the changes which took place at different epochs, and the tracing of the influence of various causes on the designs produced in different ages is a subject of absorbing interest, but is beyond the scope of our present narrative, which opens only a century ago, at which time the well-known phrase "the wooden walls of England" was no mere poetical expression, but represented the actual conditions then prevailing.

Iron or steel as a shipbuilding material was quite unknown, the few advocates of the use of iron being looked upon as dreamers and visionaries.

Sails might be said to be the universal means of propulsion, the few steamers built before that time being little more than experiments which had not yet proved the practicability of the general use of steam as a propelling agent.

The researches of James Watt (the centenary of whose death was celebrated last year) and of his fellow workers had not yet received general recognition, nor had the value of their inventions been realised by the shipowners of their day, still less by Government departments, ever conservative and slow to march with the times.

The navy and mercantile marine of Britain each consisted of a very large number of vessels of small size, the largest ship of the period being of only 1,500 tons, and British sailing ships were not then notable either for speed or for elegance in design, the French being the acknowledged masters in the science of naval architecture, although the British were the better shipbuilders.

Steamers were so few in number that a brief reference will enable one to realise the position which existed in this respect.

For many years previously experiments had been conducted to demonstrate the possibility of propelling vessels by steam, one of the most successful of the early vessels being the "Charlotte Dundas," a steam tug boat, which, in 1802, towed two 70-ton loaded vessels for nearly 20 miles in the Forth and Clyde Canal at a rate of 3½ miles per hour.

The comparative success of this vessel greatly encouraged further ventures on the same lines, and she may be looked upon as the parent of those two notable steamboats, the "Clermont" and the "Comet," whose careers set the seal of success on the steamship proposition.

The "Clermont" was designed by Robert Fulton, who, after years of disappointments, had the satisfaction of seeing his vessel make her first voyage from New York to Clermont in August, 1807, covering the distance of 110 miles in exactly 24 hours. Her engines were built at Birmingham by Boulton and Watt.

The "Comet," whose fame is world-wide, was built on the Clyde in 1812, and plied between Glasgow and Greenock. She was only 42 feet long, 11 feet wide, and 5 feet 6 inches deep, and was driven by steam paddle engines developing four horse-power, her greatest speed being 5 miles per hour. Afterwards she was lengthened to 60 feet and fitted with only one pair of wheels, whereby her speed was increased to 6¾ knots per hour, and continued on service until 1820, which brings us to the century under review. Historically, she has become of great interest, since she demonstrated clearly the possibilities of the steamship.

To present-day ideas these old vessels are clumsy and cumbersome, and the machinery with which they were fitted crude and primitive, but they will always be looked upon with the greatest respect by the thoughtful as the forerunners of the giant liners and smaller high-speed craft of to-day.

The success achieved by the "Clermont" and the "Comet" naturally led to the adoption of steam engines in other vessels, but progress was slow, the use of the new means of propulsion being confined chiefly to small coasting vessels.

It is indicative, however, of the growing confidence felt in the reliability of steamboats that 1820, the year in which Messrs. Griffins' extended the scope of their business to that of book publishing, was rendered noteworthy by the fact that mails were for the first time permitted to be carried in a steamship.

The early vessels were all fitted with beam engines, but these had, in 1820, developed into the side-lever type, the form which remained common in all paddle vessels for nearly 40 years. The growth in the size and power of marine engines soon led to the inauguration of schemes for a steamship service across the Atlantic, but none of these projects were realised till 1838, which year is ever memorable as the date on which the first Atlantic crossing under steam power alone was made.

This honour belongs to the "Sirius," a vessel only 178 feet in length and 700 tons register, and fitted with engines developing 320 horse-power, which arrived off New York on the 22nd of April in the year mentioned, having made the voyage in 17 days. Before the end of the voyage not only had all the coal been consumed, but even some of the spars had been burned.

On the following day the "Great Western" arrived, a vessel of 1,340 tons and 450 nominal H.P., which had left Bristol three days after the "Sirius" had started.

In these epoch-marking times, Messrs. Griffin had prominent place, for they issued "The Encyclopædia Metropolitana," which contained Professor W. J. Macquorn Rankine's scientific studies of great value to marine engineers, also their first book on naval architecture, entitled "A Treatise on Marine and Naval Architecture; or The Theory and Practice of Shipbuilding," by John W. Griffiths, illustrated with fifty full-page wood engravings. In this treatise, which was issued in a series of 34 parts, the writer complains that the English are behind the age in many important matters pertaining to the art of shipbuilding, and that "the hoary head of prejudice, mantled with a guise of experience, dams up the streams of knowledge."

The author proceeds to set forth the fundamental principles of buoyancy and stability to deal with tonnage, taking-off tables, water lines, certain discoveries of his own, and discusses steamboats, ocean steamers, and vessels of war. The volume now possesses considerable historic interest, and it must have exercised great influence on contemporary shipbuilding.

About this time also a very notable advance in marine engineering falls to be recorded, the adaptation of the screw propeller to steam ships. The paddle-wheels with which the early vessels were fitted, while eminently suitable for vessels plying in smooth waters, for which purpose indeed they are generally used even at the present day, had many disadvantages when fitted in ocean-going vessels.

The records of the first steamers abound with references to cases of damage to the paddle-wheels, due to the rolling of the vessel in a rough sea, and the success attained by the "Archimedes," a screw vessel built in 1839, opened a new vista to the marine engineer. Of course, the propeller fitted in that vessel was very different from those with which we are familiar to-day, but the search for the ideal propeller still continues after a period of eighty years.

With the increase in the dimensions and power of steamships it soon became apparent that the limit of size had been reached so far as ships built of wood were concerned, and attention was directed to the possibility of constructing vessels of iron.

Iron had already been used for shipbuilding, although on a very limited scale, but, in 1832, there was built the "Lady Lansdowne," a vessel of about 150 tons, notable as being the first iron steamer constructed with the intention of performing sea service.

Iron shipbuilding might, however, be said to commence with the "Great Britain," which was designed by the celebrated engineer Brunel, and was commenced in 1839. This vessel, whose length was 322 feet and displacement 3,600 tons, was the most notable vessel of her time, and the advance which her construction marked in the annals of shipbuilding may be judged from the fact that her length was 100 feet in excess of the largest line-of-battle-ship afloat.

The "Great Britain," apart from her size, embodied several novel features in design, being subdivided by transverse watertight bulkheads, and having bilge keels fitted to lessen rolling. These are, of course, commonplace arrangements nowadays, but in 1839 their presence was a tribute to the genius of the designer.

Iron had, of course, been used for fastenings, etc., in all wooden vessels, and, as these increased in size, iron reinforcements of various forms were fitted, but with the advent of the "Great Britain" iron became the chief material used in shipbuilding, and the construction of wood ships declined until it has become almost a lost art.

The physical properties of iron were not, however, fully appreciated at that time, nor were the principles on which a structure of this material should be designed very well understood, with the consequence that the scantlings of the first iron vessels were based upon the practice prevailing in wood ships, the result being a spacing of frames so close, and a thickness of shell so great, as to excite wonder in the mind of the modern naval architect.

With greater experience the successors of these early vessels were vastly improved, and the full advantages of the use of iron began to be realised.

During this period of transition Messrs. Griffin do not appear to have issued any volumes dealing directly with ship construction, but several books of a very helpful nature, particularly to ships' officers, appeared from their press. One of the first of these is "The Mariners' Friend," or "Polyglot Technical Dictionary." This seems to have been the earliest book of its kind, and contains upwards of 4,500 nautical, steam, and shipbuilding terms in no fewer than ten languages. The labour required in the compilation of such a dictionary can hardly be appreciated, and it must have been of considerable service to those classes for whom it was intended.

The "British Consuls' Manual" and the "Mercantile and Maritime Guide" were two notable publications in 1856.

The former volume deals with the origin of Consular Institutions and explains fully the duties of a consul, particularly as regards his line of action towards shipowners and master mariners. It must have saved a harassed consul many worries in his dealings with seamen, and in settling the differences which so often arise between the latter and the officials at a foreign port.

The "Mercantile and Maritime Guide" was written with the object of "furnishing to all persons connected with the Mercantile and Maritime interests of this country such matter as will inform them of their rights and duties, and enable them to transact their business with accuracy, confidence, and facility," and a glance at the contents of the various chapters is sufficient to show that all subjects which might be useful to the persons mentioned have been included, there being few difficulties which could have been encountered which are not dealt with, from pilotage to smuggling, or from rates of freight to marine insurance.

The "Circle of the Sciences" (1861) was a series of volumes dealing, as its title implies, with all scientific subjects, and No. 5 is devoted to Navigation and Practical Astronomy. To the ship's officer this book must have been specially valuable, giving, as it does, simple explanations of the method of taking observations, together with a description of the instruments employed. The underlying mathematical theory and simple calculations regarding eclipses of the sun and moon, and the transit of the stars are described.

Reference to these volumes has caused a slight digression from the theme of tracing the progress made in marine engineering, which, as the years passed, made great strides forward.

As already stated the beam engine was followed by the side lever type, which remained the common form for many years, and with the advent of the screw propeller the paddle engine was slightly modified and arranged to drive the propeller shaft by means of chain gearing. This system was adopted in order to increase the number of revolutions of the propeller, the revolutions suitable for paddle-wheels being too small for the propeller.

With increasing knowledge, however, the engines were arranged to run at a higher speed, which, in combination with propellers of greater diameter, enabled the gearing to be dispensed with, and led to the evolution of the inverted direct-acting engine, which is the common type to-day.

These changes were accompanied by a considerable increase in the steam pressure, which, in James Watt's engines, had been as low as 7 lbs. per square inch, and in the " Comet " had been only 15 lbs. per square inch.

The boiler of the " Comet " was merely a cubical tank with the fire beneath, the boiler being what is known as " externally fired."

It soon became apparent that much better results could be obtained if the furnace was placed inside and incorporated with the boiler, and by the adoption of this arrangement steam pressure had increased to about 30 lbs. per square inch in 1845, and the pressure was gradually increased until 60 lbs. per square inch became the common practice. This increase was, however, only attained by the construction of the compound marine engine in the late fifties.

Previously the steam, after emerging from the boiler, had acted upon one cylinder only before passing to the condenser. One cylinder is not sufficient to take full advantage of the power latent in the steam, and by adding a second cylinder, into which the steam is passed after leaving the first, a much larger proportion of the power is abstracted from the steam before it is permitted to go to the condenser. Very large economies were effected by this change, which, in conjunction with an increase of boiler pressure to 90 lbs. per square inch, reduced the coal consumption per horse-power by one-half.

A further extension of this principle is seen in the triple-expansion engine, which made its appearance about 1880.

About this time there was published by Messrs. Griffin the first edition of the "Manual of Marine Engineering," by A. E. Seaton. It would not be too much to say that Mr. Seaton's book immediately was recognised as the standard work on the subject, a place, which in its present edition, it still retains. Published in 1883 this volume rapidly ran through numerous issues, each brought thoroughly up-to-date, and now, after more than forty years, in its eighteenth edition it is as indispensable as ever.

At the time of publication there was a dearth of text-books showing the application of theoretical principles to the design and construction of marine machinery and analysing the results of the experience already gained, and Mr. Seaton's book gave a considerable fillip to the study of the subject.

After beginning with a general description of marine engines, the author proceeds to deal with the theory of steam and the thermal and mechanical efficiency of the marine engine. The detailed design and construction of the engines and boilers, and, in the later editions, oil engines are described, while a chapter is devoted to the subject of lubricating oils, the importance of which is not always realised.

Altogether the volume forms an unsurpassed compendium of marine engineering, and the engineer who has thoroughly studied it must become a master of his craft.

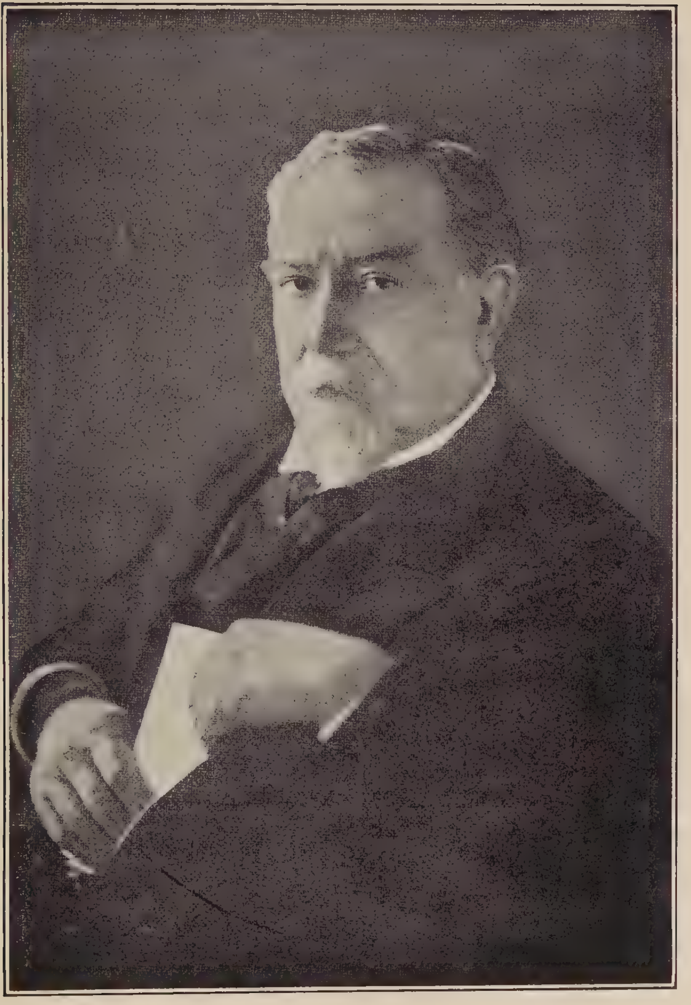
Another volume dealing with " Boilers, Marine and Land," by T. W. Traill, for many years Chief Engineer to the Board of Trade, was published about the same time as Mr. Seaton's work, and is devoted particularly to the practical design of boilers. The numerous rules and tables given crystallise the results of the lifelong experience of the author and enable a great saving of time and labour to be effected by designers.

The advances in size and the improvements in design of engines and boilers noted in the above volumes were contemporary with a marked increase in the dimensions of ships which continued to grow in size from year to year. A very important factor in facilitating this increase was the general adoption, as a shipbuilding material, of steel, the use of which, in this respect, dates from about 1880, but a number of cases of failure of steel plates which occurred somewhat delayed its common use and caused a feeling of distrust regarding its suitability. With further investigation the causes of failure were eliminated, the study of the subject being greatly helped by the excellent series of works on Metallurgy edited by Sir Wm. Roberts-Austen and issued by Messrs. Griffin. "The Metallurgy of Steel," by F. W. Harbord and J. W. Hall has become the standard work of reference.

The continued growth in the size of ships naturally led to an increasing interest in the theoretical side of naval architecture, on which subject, considering the important place the industry occupied in this country, the paucity of literature was surprising. In particular, the subject of stability had been badly neglected when attention was focussed on it by the loss of the "Captain," a full-rigged vessel of the Royal Navy, which capsized in the Bay of Biscay with the loss of all hands in 1870, and the great loss of life which accompanied the upsetting during the process of launching of the "Daphne" on the Clyde in 1883.

Nothing could have been more appropriate, therefore, than Griffin's publication, in 1885, of Sir E. J. Reed's "Stability of Ships." The author occupied for some time the post of Chief Constructor of the Admiralty, and his name is one that will always be memorable in the annals of scientific naval architecture.

His work was the first comprehensive treatise on stability in English, and dealt with all aspects of the subject. The British shipbuilders of that date were decidedly practical men who left the investigation of the more abstruse matters connected with their business to their French colleagues. Reed's book contains very full descriptions of the methods of French Naval Architects and of their researches in the geometry of the stability curves of floating bodies, together with explanations how these results could be more easily applied in



Sir Edward J. Reed, K.C.B., F.R.S., M.P.,
Author of
"The Stability of Ships."

the everyday work of the shipyard. The interest thus aroused is reflected in the systematic way in which stability is now calculated.

The increased demand for technical instruction was not confined to the builders and designers of ships, but extended to those whose duty it was to man the vessels after commission. To meet this requirement Messrs. Griffin published, in 1897, the well-known work "Know Your Own Ship," by Thomas Walton. As the title implies the book was primarily intended for ships' officers, but appealed to a much wider circle.

The author, who was than a lecturer on naval architecture in a nautical school, dealt with his subject in a manner which, while thoroughly scientific, was as free as possible from abstruse technicalities. Various chapters are devoted to construction, stability, tonnage, and also to the very important subjects of loading, ballasting, and the effect of shifting cargoes.

The later regulations of the Board of Trade requiring a knowledge of these items from candidates for officers' and masters' certificates were no doubt influenced by the fact that such information was available in a form which could readily be grasped.

The publishers also issued, for the benefit of the engine-room staffs, a somewhat similar volume, "Engine-Room Practice," by J. G. Liversidge (now Engineer Rear-Admiral). It is now in its tenth edition, and contains a very complete description of the practical carrying-out of the every-day duties of a marine engineer, together with many details and hints regarding the management of engines and boilers and the numerous auxiliaries found in a ship's engine-room.

Two other books of great usefulness should here be mentioned—viz., Hurst's "Valves and Valve-Gearing," and Butler's "Transmission Gears," as they have become absolutely necessary to designers.

To the same date belongs Seaton and Rounthwaites' "Pocket-book of Marine Engineering Rules and Tables," which, in its 14th edition, contains, in a condensed form, all the rules and formulæ which the designer requires to use in his daily work. It has proved of the utmost value, and is familiar to the entire profession.

The closing years of the nineteenth century were notable for the appearance of many novel types of ships, trunk deck, turret deck, whaleback, and many others, the objects of the designers being generally to effect a saving in the weight of the hull, while, at the same time, maintaining the necessary strength of structure.

In "Steel Ships," by Thomas Walton, already referred to as the author of "Know Your Own Ship," the development of these types is traced, and the comparative advantages of each is discussed. The structure of ships and the various processes of the shipyard are clearly explained, and very useful chapters are devoted to a description of the manufacture of steel, a subject with which the numerous users of this material are often not so well acquainted as they might be.

The close of the nineteenth century affords a very convenient stage from which to survey the progress made during the epoch-marking years which had preceded. For many years a description of the leading British ships would have comprised all that was best in the domain of naval architecture, but the rise and growth of the German mercantile marine introduced a new factor which made for an even more rapid advance in the size and power of steamers.

From the "Comet," of 1812, with a length of 42 feet, horse-power of 4, and speed 5½ miles per hour, there had been a continued increase in size and power, till, in 1900, the largest British ship, the "Oceanic," had a length of 705 feet and a horse-power of 29,000.

Pride of place was, however, accorded to the Cunard Company's greyhounds, the "Campania" and "Lucania," built in 1893, which had attained the hitherto undreamt of speed of 22 knots, and made the Atlantic crossing in five and a-half days.

They were considered to be the last word in naval architecture, and to have permanently secured for this country the blue riband of the Atlantic; but a rude shock awaited the optimist when, in 1897, the German-built liner "Kaiser Wilhelm der Grosse," a vessel slightly larger than her British contemporaries outstripped their performance by attaining a speed of 22·8 knots.

The German success with this vessel was followed a few years later by the still more wonderful achievement of the "Kaiser Wilhelm II.," the speed of which was 23½ knots. That the fastest liners in the world should sail under the German flag was galling to the pride of British owners, and plans were immediately mooted for the construction of vessels which would outstrip their German rivals in speed and power. But when the problem was reduced to calculations and figures it became apparent that there was little scope for increase in the size of the reciprocating engines, then the standard means of ship propulsion, nor could sufficient room be found in a vessel to contain them.

Attention was consequently directed to the potentialities of the marine steam turbine, which had made its debut in a somewhat sensational way at the time of Queen Victoria's Diamond Jubilee celebrations.

At the great naval review at Spithead there appeared a small vessel, the "Turbinia," which raced around the fleet, her speed enabling her to leave the fastest picket boats behind.

The steam turbine, in theory at least, has been well known for ages, the oldest steam engine of which a record has been preserved, that of Hero of Alexandria, B.C. 130, having been of this form. The "Turbinia," which was only of 44 tons, but was capable of reaching a speed of 34 knots, had been built by Sir Charles Parsons in order to demonstrate the possibilities of the marine steam turbine which he had invented.

When the Cunard Company desired to construct new liners, which would be an advance on the German ships, a commission, partly nominated by the Government, was appointed to inquire into the practicability of adopting turbines instead of reciprocating engines.

There was an enormous difference in size between the "Turbinia" and the projected vessels, and but little was known regarding turbines at that time. Hence the publication by Messrs. Griffin of "The Theory of the Steam Turbine," by Alexander Jude, was most timely. Sir William White wrote unqualified words of praise concerning this book, and it remains the standard work on the subject.

They also issued a smaller book by Professor J. H. Biles, who, after giving an historical account of the steam turbine and a description of machinery of this type, devoted much space to a consideration of the question of securing a combination of turbine and propeller so as to secure maximum efficiency.

The turbine is essentially a high-speed engine, while the best results, so far as the propeller is concerned, can only be secured at a moderate number of revolutions, and the problem of obtaining the best combination is one which taxes the skill of the best experts.

As is well known the Cunard Company finally decided in favour of the turbine, and the outcome was the construction of the "Lusitania" and "Mauretania," the latter of which is still the pride of the mercantile marine. These historic craft had a length of 790 feet, and a horse-power of 68,000 in their turbine engines, which propelled the vessels at a speed of 26 knots. The time of the voyage from Liverpool to New York was reduced to a little over five days, which contrasts with the time of fourteen days taken by the "Great Western" in 1838. Since the date of these leviathans other mammoth ships have been built, but no attempt has been made to rival the "Mauretania" in speed.

The attention of engineers has been rather directed to effect economies in the consumption of fuel, and the advances made may be measured by comparing the consumpt of 4 lbs. per horse-power per hour of the early steamers with the corresponding figure of 1½ lbs. or less in the best present-day practice.

One of the principal methods by which this improvement has been effected has been by the improved efficiency of the propeller. The study of this subject, largely by means of model screws in the experimental tank, has occupied the attention of engineers since the early days of screw ships, and every engineer of note is found in the list of inventors.

The results of the analysis of these tests and of experiments carried out on full-size vessels are summarised in Seaton's " Screw Propellers," first published in 1909, and now in its second edition.

The mathematical investigation, which is very complicated and not very satisfactory, of the theory of the screw is not touched upon, but rules and formulæ are given by means of which the designer should be able to obtain a screw approximating to maximum efficiency. The many problems connected with propellers are still a fruitful field open for original research.

The subject of liquid fuel is one in which Messrs. Griffin have specialised, and it was through their enterprise that the monumental work on " Petroleum," by Sir Boverton Redwood, was published. A revised edition, which the author had almost ready to commit to press at the time of his lamented death, will be issued shortly. A compact but comprehensive text-book, " Oil Fuel: its Supply, Composition, and Application," by Edward Butler, has proved of the utmost value during recent perilous years.

Marine Diesel engines have proved their efficiency, and here again Messrs. Griffin have presented the recognised standard work. Professor Supino, of Milan, wrote with authority on this subject, and with great clearness, and his work was admirably translated. The English edition was invaluable during the war, and the U.S.A. paid tribute to the publishers' enterprise by purchasing large numbers of copies for war service. A pocket-book on the " Maintenance and Running of Marine

Diesel Engines," by John Lamb, is the latest word on this subject.

Contemporaneously with the increased study of the problems relating to the machinery, there has been similarly increased attention paid to the ship. The transactions of the various learned societies connected with the shipbuilding industry bear eloquent testimony to the time and ingenuity devoted to the theoretical side of naval architecture, and the contents of the best of these papers are skilfully digested and utilised in "The Design and Construction of Ships," by Professor Sir J. Harvard Biles, first issued in 1910, and now in its third edition. The author has been for many years one of the leading authorities on naval architecture, and his wide knowledge, combined with his teaching experience, has enabled him to produce a great work, two volumes of which have been published, and are admittedly the standard work on the subject, as is Seaton's on the allied subject of Marine Engineering. Professor Biles' book is divided into—Volume I., on Calculations and Strength; Volume II., on Stability and Rolling, and Resistance and Propulsion, and each of these is dealt with in a masterly way. The sections are of such uniform excellence that it is difficult to single out any feature for special mention, although possibly the chapters on Rolling and Propulsion may be referred to as containing much information that is not readily available elsewhere.

Volume III. is impatiently awaited, and the complete work will doubtless remain the standard for many years, and will be the every-day handbook of the teacher and student of naval architecture.

With the growing complexity of the modern engine-room the Board of Trade have naturally required a wider knowledge on the part of the engineers whose duty it is to supervise its management, and have instituted more stringent regulations regarding the examination of candidates for the higher grades. No student who has mastered the contents of Griffin's "New Guide to the Board of Trade Examinations for Marine Engineers" need regard the ordeal of the examination with trepidation, since it would be hard to conceive a book more suitable for its intended purpose.

Limits of space prevent detailed consideration of the numerous other works published by Messrs. Griffin on the subjects included in the title to this article, but reference must be made to their widely-known Nautical Series.

That they have succeeded in capturing the interest of the student-seaman, and by the sheer attractiveness of these books compelled his attention is immensely to their credit. Reference has already been made to Walton's "Know Your Own Ship," but Capt. D. Wilson-Barker's "Elementary Seamanship" has been equally successful, and other volumes have been of valued assistance. Such a work as "A Medical and Surgical Help for Shipmasters and Officers in the Merchant Navy," by W. Johnson Smith, has proved almost indispensable.

"Things a Sailor Needs to Know," by D. Wilson-Barker, R.D., indicates clearly the wide range of knowledge the sailor of to-day should have acquaintance with, and by these carefully elaborated notes he has again proved himself the sailor's friend. His other work, jointly with Captain Alfred Carpenter, R.N., D.S.O., "Nature Notes for Ocean Voyagers," is a book of intense interest, conveying accurate information in a fascinating and instructive manner.

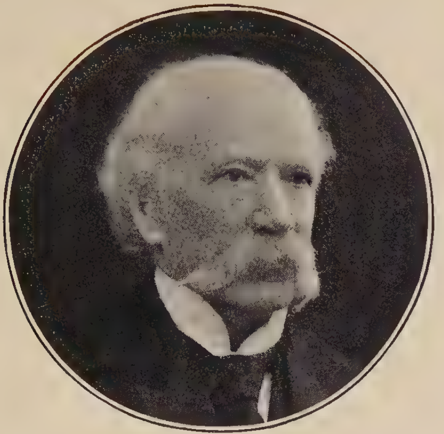
On the subject of aero-engines, aeroplanes, and seaplanes, Griffin's books were first in the field, and of the greatest service.

As will be seen from the present brief review the record of the past century has been one of steady progress in shipbuilding and marine engineering, a progress which still continues, and of which it is impossible to predict the limit.

Every improvement has produced new difficulties and problems which time and patience alone could solve satisfactorily. With the wider diffusion of scientific knowledge, and the raising of the educational standard of those engaged in shipbuilding, there has been a growing realisation of the importance of the investigation of the many yet unsolved problems in what is one of our principal industries, and for the instruction of those engaged nothing is more essential than the provision of suitable text-books.

Like the mariner, whose interests Griffin's have served so well during the century they celebrate by this volume, they have boldly ventured right out on the ocean, guided by the stars, and have not timidly hugged the shore for safety. Their present catalogue, like a lighthouse, flashes out on the immediate future and reveals a wealth of coming books they have at press, such as "The Electrical Equipment of Ships," by C. H. Wordingham, C.B.E., until recently the Electrical Engineer-in-Chief to the Admiralty, and the President of the Institution of Electrical Engineers. Such a subject dealt with by such an authority will be waited for with great expectancy, and will command a wide circle of interested readers. It deals with electrical systems, generators, wiring, design of switchboards, lighting, motors, control gear, driving of fans, pumps, etc., heating and cooking, and a hundred other things. Naturally "Concrete Ship Construction" finds a place, and Captain Beadle and Charles Hurst will put at disposal their practical experience on this subject, whilst James Milton has nearly ready an entirely new and up-to-date work on "Refrigeration: Marine and Land."

No Publishing House has a finer record in providing such works than Charles Griffin & Co., Ltd., and in the days of strenuous competition on which we are entering there can be few more cheering signs than the continued vitality of this famous house which gives promise in the future of even excelling its own splendid past record.



Professor W. GOWLAND, F.R.S.

Chapter VII.

AN OUTLINE OF THE PROGRESS OF METALLURGY AND METALLURGICAL LITERATURE DURING THE LAST HUNDRED YEARS.

By W. Gowland, A.R.S.M., F.R.S., Past President of the Institution of Mining and Metallurgy and the Institute of Metals, Emeritus Professor of Metallurgy in the Royal School of Mines.

In the Early Part of Griffin's Century—Great Britain without a School or College for the Study of Metallurgy—In 1851 the Government School of Mines established—The Royal School of Mines—Dr. John Percy, Professor of Metallurgy—The Diploma A.R.S.M. of world-wide reputation—Griffin's Enterprise in providing Metallurgical Books—John Arthur Phillips and a great Succession—Every Advance in Metallurgy reflected in Griffin's Publications—Their Text-books on Assaying unequalled anywhere—On Foundry Practice, Micrography, Pyrometry, Temperature Measurement, Refractory Materials, &c.—The most Valuable Books in the Empire—Griffin's Books unexcelled in any Language.

Chapter VII.

AN OUTLINE OF THE PROGRESS OF METALLURGY AND METALLURGICAL LITERATURE DURING THE LAST HUNDRED YEARS.

THE completion of a century of exceptionally important work by the firm of Charles Griffin & Company in the literature of metallurgy and the allied branches of technology affords a fitting opportunity for a consideration of the advances made in this country in the extraction of metals from their ores, their adaptation to the needs and progress of our industries, and the prominent part played by the Firm in contributing to these advances.

Great Britain without a Metallurgical School.

Up to the year 1851 there was no school or college in Great Britain where metallurgy was taught as a distinct subject. Only as a branch of chemistry was there any teaching of it, and, needless to say, this was of a most elementary and imperfect character, as the teachers, however eminent they may have been as chemists, had no practical acquaintance with the operations necessary for the successful economic extraction or treatment of the metals.

At the mining schools in Germany, Austria, and

France alone could a satisfactory course in metallurgy be obtained, and to these schools it was imperative for us to resort for the metallurgical training which could not be got at home.

It was not until 1848 that any attempt to remedy this serious deficiency was contemplated. In that year the Government were induced to sanction the erection of the Museum of Practical Geology in Jermyn Street, and the long cherished scheme of Sir Henry de la Beche, Director General of the Geological Survey of Great Britain and Ireland, for a school of mines was about to be realised.

Memorials, it is true, had been presented to the Government from time to time urging the need of a school similar to those which had long existed in Germany, Austria, and France, but it was only through the exertions of De la Beche and his influence with the Government that the establishment of such a school became possible in this country.

In the following year a committee of the House of Lords reported that "Among those best qualified to speak upon the point, a want appears to be felt of facilities for acquiring mining education, such as are provided by the mining schools and colleges established in the principal mining districts of the Continent, apparently with the most beneficial effects."

The Royal School of Mines.

In May, 1851, the museum building, on its completion, was formally opened by Prince Albert, and, in November of that year, the Royal School of Mines, under the title of the "Government School of Mines and of Science Applied to the Arts," received its first students.

Its first Professor of Metallurgy was Dr. John Percy, one of the greatest teachers of the nineteenth century. Metallurgy was then practised as an empirical art; by his teaching and researches he secured for it a scientific basis, and by his classic volumes created its literature in this country.

The school was removed to Exhibition Road, South Kensington, in 1880, and, nineteen years later, the foundation stone of the spacious building which it now occupies was laid by His Majesty King Edward VII. In spite of inadequate Government aid it ever maintained its old traditions and vitality. A succession of great teachers has made it famous, and a long array of graduates has made its diploma, A.R.S.M., of world wide reputation.

In its new quarters, as an important division of the Imperial College of Science and Technology, it has a fair endowment, and an equipment unsurpassed in any country for the facilities afforded for metallurgical and mining training.

Griffin's Enterprising Publications.

Metallurgy, the art of extracting metals with profit from their ores and adapting them to various purposes of manufacture, was still without a text-book or manual in the English language, although in no country at the time were metallurgical operations conducted on so vast a scale as in Great Britain. It had been taught, as I have already pointed out, merely as a branch of chemistry, and the student and practical metallurgist had to rely on treatises of that science for a knowledge of metallurgical processes, in which it is needless to say the information to be obtained was of the most elementary character. For a knowledge of the furnaces, processes, and appliances in use in the practical operations of the art recourse had to be had to the writings of German, French, and other foreign metallurgists. This lamentable deficiency in the technical literature of our country remained unremedied until, by the enterprise of the House of Griffin, then Richard Griffin & Co., a "Manual of Metallurgy," by John Arthur Phillips, was published in 1852. The rapidity with which the first edition was exhausted, a second one being issued in 1854, sufficiently proved that such a treatise was urgently required by those who were engaged in metallurgical operations or studies. The aim of the author was to give an account of the most important methods of extracting the metals from their ores, of the fuels and refractory materials employed in the operations, and of the physical and chemical properties of the metals themselves. The book is still a valuable store-house of knowledge for all desiring information on the metallurgy of the time in which it was written.

In later times, as metallurgy progressed and the old processes became obsolete or altered beyond recognition, successive editions were issued, notably the revised and enlarged edition in 1887, of which the late Professor Bauerman was the author, and which, during his life, was one of the most important text-books.

It will now be of interest to consider briefly the chief advances made during the last hundred years in the metallurgy of the most important metals, and in the literature relating thereto.

Iron and Steel.—The first half of the nineteenth century, about a decade after the establishment of the House of Griffin, is specially notable in the history of iron for the invention by Neilson, in 1828, of the hot blast in the smelting of iron ores. By this invention a complete revolution in the iron industry was effected, and in it it may be said that the modern development of iron manufacture had its origin. Before its introduction rather more than 8 tons of coal converted into coke were required for the production of 1 ton of pig iron. With increased temperature and pressure of the blast, and larger furnaces, the amount of coke per ton of iron has suffered gradual reduction until, in American practice, it is only about 16 cwts.

Since that time the metallurgy of iron has made extraordinary advances.

In the first half of the nineteenth century South Wales and Staffordshire were the chief iron-producing districts in Great Britain, but almost simultaneously with the foundation of the Royal School of Mines the Cleveland district was opened up by Messrs. Bolckow & Vaughan, who, in 1851, erected blast furnaces at Middlesbrough, and by the erection of the Clarence Works by Messrs. Bell Bros. The Northampton district was developed at the same time, other districts followed, and Great Britain became the greatest producer of iron in the world until 1890, when the United States wrested from her this proud position, and still retains the first place among the iron-producing countries.

The weekly production of the largest Staffordshire furnace in 1860 was only about 200 tons of iron per week, whereas in America at the present time a production of about 700 tons per day has been reached.

There is nothing to record of special interest in respect to the manufacture of wrought iron.

Its production by the puddling process has gradually diminished owing to the extensive use of mild steel for the purposes for which it was used.

The process has undergone no radical change, in fact, the description of the operation given in Phillip's "Metallurgy," 1854, very fairly represents the practice of to-day.

The first decade of the second half of the nineteenth century is specially remarkable for the dawn of the Age of Steel. Up to this time the manufacture of steel was on a comparatively small scale, its production being confined to the old cementation and crucible process, and on account of its costliness it was restricted to the manufacture of cutlery and tools.

In 1856 Sir Henry Bessemer invented the process of steel manufacture which bears his name, and the production and extended uses of the metal advanced by leaps and bounds.

A few years later an even more important method of manufacturing steel, the open-hearth process, was invented by Sir W. Siemens. In this process the operation is more under control, and the product more uniform in character than is the case in the Bessemer process.

By neither of the above processes could steel be made from phosphoric iron, a serious defect owing to the comparative scarcity of iron ores free from injurious proportions of phosphorus, whilst phosphoric ores were extraordinarily abundant. This was, however, remedied by the extremely important invention of the basic process by Thomas and Gilchrist in 1879, an invention of such far-reaching results that, in 1904, the world's production of steel by that process exceeded that made in acid-lined converters and furnaces.

In this connection it is no exaggeration to say that in the history of steel no factor has had so great and world-wide an influence as this invention of Thomas and Gilchrist.

Boilers, rails, ships, bridges, and guns, which formerly were of wrought iron, are now made of steel, the product of these new processes, Bessemer steel being chiefly employed in the manufacture of rails, and Siemens steel for constructive purposes, guns, etc., requiring metal of uniform quality, and for every kind of steel castings.

Further, the necessity of obtaining steel of exceptional purity for some purposes has led to interesting developments in refining in the electric furnace. By its means all grades of steels can be made equal to high-class crucible steel. Such steel is now being largely produced, and is competing with crucible steel, and, in the near future, the electric furnace will probably be a powerful competitor with the crucible (Harbord).

GRIFFIN'S BOOKS REFLECT ADVANCES IN METALLURGY.

Notwithstanding the great importance of the manufacture of iron and steel in our country, it was not until 1875 that any special book had appeared dealing systematically with the advances in the metallurgy of iron since the introduction of the processes of steel manufacture mentioned above, although valuable chapters on the subject are contained in Phillips and Bauerman's "Elements of Metallurgy" published by Charles Griffin & Co., 1887.

Percy's invaluable monograph had, indeed, appeared, but too early to embrace the new and rapid progress in the metallurgy of the metal due to the extensive adoption of these processes.

In that year the House of Charles Griffin & Co. published the "Metallurgy of Iron," by Professor Turner, having had the good fortune to secure, in its preparation, the services of that specially qualified metallurgist. In its last edition it is still the chief text-book on English practice.

Steel was still without a special treatise on its metallurgy until 1903, when this serious deficiency was remedied by the issue by our old Firm of "The Metallurgy of Steel," by F. W. Harbord. The need and value of this book was amply testified by the exhaustion of the first edition, and in less than two years from its publication. It contains a full description of the various branches of steel manufacture, both from a metallurgical and an engineering standpoint, and a clear exposition of the physics and chemistry of steel in relation to its manufacture.

It is indispensable to the student and to every one engaged in the actual manufacture of steel; in fact, no other book in any language contains such a comprehensive account of this vast subject. The promised volume, "Researches on Special Steels," by Sir Robert Hadfield, Bart., is awaited with great interest.

Copper.—The production of the metal copper in Great Britain as compared with that of the copper-producing countries of the world has undergone a serious reduction since the beginning of the nineteenth century. It was then about 75 per cent. of the output of the world.

Previous to that time Neath and Cornwall appear to have been the chief producers, but, with the establishment of the Hafod Works, in Swansea, by Richard Hussey Vivian and his brother, John Henry Vivian, in 1810, that city soon became the chief centre of copper smelting, and the smelting of home ores underwent a great expansion, in fact, reached its maximum in the decade 1831-40, which was maintained with slight fluctuation for thirty years. From that time a decline set in owing to a decrease in the output of British ores and the development of foreign mines. Swansea gradually lost its position as the chief centre of the copper smelting industry.

Between 1861 and 1870 Chili became the world's greatest producer, but in the decade 1881-1890 the United States definitely took the lead, and has retained its supremacy up to the present day.

The metallurgy of copper in the period under consideration has been the subject of not less momentous changes than those of iron and steel.

During the century the smelting of copper ores in this country was conducted exclusively in reverberatory furnaces of small dimensions. In 1861 they were only 13 feet in length, and even at the end of the century, in the most advanced works, their length did not exceed 25 feet.

The blast furnace was only used in a few works for smelting slags, although it was the favourite furnace abroad. Even as late as 1880 Mr. H. Hussey Vivian, in a lecture at Swansea in discussing the relative advantages of two systems of reverberatory and blast furnace smelting, said :—" South Wales against the World ! " and pronounced in favour of the reverberatory.

Since that date, however, in the United States the blast furnace has undergone unprecedented development in construction by the adoption of water-jackets, and by an extraordinary increase in the length of the old furnaces; it had thus been brought in the latter part of last century to such a high state of efficiency that it had almost entirely displaced the reverberatory throughout the world.

On the other hand, during recent years the reverberatory furnace has been developed, also in the United States, so that, in its large modern form (120 feet in length), its equipment, mode of working and the use of powdered coal as fuel, it is again coming to the front, and in several important works has displaced the blast furnace.

For example, the capacity of one of the largest reverberatories in America has reached 600 tons a day, which is equal to that of an ordinary blast furnace, and there is not necessarily a very great difference between the cost of smelting in the two furnaces, but this, of course, depends upon the nature of the ore available and on local conditions.

One of the most, if not the most, important advances in the nineteenth century was the introduction of pyritic smelting, by which sulphide ores can be smelted by the heat generated by their own oxidation aided by only a very small percentage of coke.

England can certainly claim the credit of this invention, although the United States was the first to make it a practical success. To John Hollway the honour belongs of having established the principles of this important process in 1878.

Two years later these principles were applied by Manhes to the treatment of copper mattes, by which by the adaptation of a modification of the Bessemer converter, metallic copper could be obtained direct without the use of fuel, and the old tedious and laborious process of roasting could be dispensed with.

A weak point in this Bessemerizing process was the rapid destruction of the converter lining, which was originally of siliceous material. This serious defect was, however, remedied by the introduction, in 1910, by Pierce and Smith of a lining of basic material, an improvement of such great economic importance that it has been universally adopted.

Among other advances in the century, not the least was the adoption of electrolytic refining by means of which the valuable foreign metals present in copper can be recovered, and the copper itself obtained in a purer state than was possible by the old refining operations. This method of refining is also of English origin, the inventor being James Elkington, of the well-known firm of electroplaters, and the first works for carrying out the process was erected by him at Pembrey, Wales, in 1869.

During recent years remarkable progress has been made in the treatment of the poorer copper ores from which the metal could not previously be extracted with benefit, by the application of the flotation process to their concentration, a method which, in the highest degree of probability, will enable certain ores containing not more than 1 per cent. of copper to be economically worked.

These years have also been notable for an extraordinary extension of the use of wet methods in the treatment of similar ores. The success which has now been reached by both these systems of work would seem to indicate an increased substitution of pyrometallurgical by hydrometallurgical operations.

Notwithstanding the industrial importance of copper and the vast scale on which the operations for its extraction are conducted, the number of books dealing thoroughly with the metal is comparatively small.

The first contribution to its literature was a paper on "Copper Smelting," presented to the Royal Society by J. H. Vivian in 1822.

The paper contained an account of the operations of the "Welsh Process as conducted at the Hafod Works," and was deemed to be of such importance that the author was elected F.R.S. in 1823.

In 1848 an elaborate description of the Welsh process was published by Le Play, formerly a Professor of Metallurgy at the Ecole de Mines, Paris. It was not, however, until 1861 that the metallurgy of copper was first comprehensively and effectively dealt with. In that year the first of the series of incomparable volumes on metallurgy by Dr. Percy appeared. It contains a masterly treatise on the metallurgy of the metal as practised at the time, and is especially valuable for the records of the experimental work carried out in the author's laboratory in demonstration of the reactions and scientific principles on which the smelting and refining of copper are based.

From 1861 to 1864, when Peters' "Modern Copper Smelting" was published in New York, the metallurgy of the metal was confined to monographs and papers on the various phases of its treatment, and to treatises on general non-ferrous metallurgy.

From that date America, having now established her supremacy in the smelting of the metal, takes the lead in its literature.

Quite a large number of papers by copper metallurgists have been contributed to the *Transactions* of the Institution of Mining Engineering and technical journals, and several important books have been published, notably those by Peters, Lang, and Hofman.

GRIFFIN'S UNDAUNTED IN FACE OF DISAPPOINTMENT.

On the other hand, it is worthy of note that the credit of publishing the first book in this country giving an accurate account of the modern methods of copper metallurgy, Levy's "Modern Copper Smelting," 1912, belongs to the House of Griffin.

It was not, however, owing to oversight or want of enterprise that they had not provided earlier a book on the subject, in fact, one by a well-known expert had indeed been partly printed many years ago when, unfortunately, owing to unforeseen circumstances beyond their control its publication had to be relinquished.

Again, quite recently too, the publication by the old Firm of an exhaustive treatise became impossible owing to the death of the author, a metallurgist specially distinguished for his wide experience in the metallurgy of copper, when the greater portion of the book had been written, but unhappily destroyed.

Lead.—The history of lead is less eventful than that of the other metals, many advancements have indeed been made in its metallurgy, but there have been no such startling and radical changes in the methods of extracting the metal from its ores as we have recorded in the cases of copper and iron.

In the first half of the century under consideration the smelting of lead ores in Derbyshire was carried on in the ore-hearth until about 1811, when the reverberatory furnace was introduced from Wales, where it had been in use in 1698 and probably earlier. The ore-hearth still continues in use in the north of England and Scotland, and, in a modified form, at some works in the United States. During the last few years a radical improvement in this old furnace has been made by Mr. W. E. Newnham in the United States, in which mechanical rabbling replaces that formerly done by hand, an improvement so great that for smelting pure ores it can compete with even the modern blast furnace.

During the century lead smelting in the old Flintshire and other forms of reverberatory furnace had become almost obsolete on account of the high cost of the operation and the loss of metal. The blast furnace, therefore, has come into universal use in all the chief centres of the lead smelting industry. All smelting ores can be worked in it, and any ores containing 4 per cent. silica must be so treated.

It may be noted here that the water-jacket, one of the most important innovations in blast furnace construction, was first applied to a lead-smelting furnace (1875).

By far the greatest and most important improvements in lead smelting were the introduction, near the end of last century, of the blast-roasting process of Huntington and Heberlein, and subsequently the roast-sintering process of Dwight and Lloyd. These processes have displaced the old wasteful and costly methods of roasting in reverberatory furnaces, as they furnish a material specially suitable for blast furnace smelting.

There is little further to record in the advance of methods and appliances for the actual extraction of the metal except the application of the flotation process.

The nineteenth century is, however, specially noteworthy for far-reaching improvements in the processes and plant for the desilverisation of lead. The process of simple cupellation, which dates from prehistoric times, was the only method practised up to about the third decade of the century. The first great advance was made in 1829 by the invention of the Pattinson process by which, by repeated crystallisation, lead rich in silver could be obtained from lead poor in the precious metal, and, although cupellation was still required, yet only a greatly diminished amount of the metal had to be so treated; the immediate result being that large quantities of silver were recovered from lead that hitherto could not be extracted with profit.

A second, and even more important, advance was made by the invention of the Parkes process in 1850. This process is based on the greater affinity of silver for zinc than for lead, so that when lead is melted with the addition of zinc, the crusts of zinc obtained on cooling contain the silver and any gold which may be present, and from these crusts the precious metals are recovered by distilling off the volatile zinc and cupelling the rich argentiferous lead. Owing to the advantages of the Parkes process as compared with the Pattinson process as regards the less time and labour required, and the general lower cost of treatment and diminished losses, the process is now universally employed.

During later years there have been no similar radical changes, but great improvements have been effected in the construction of the plant and in the details of the process, notably an enormous increase in the size of the pans, and the introduction of mechanical appliances for the zincing operations.

The latter half of the century is also noteworthy for the adoption of more efficient means for the condensation and collecting of the dust and fume which had hitherto been a serious source of loss of lead in lead-smelting plants. In 1870 Dr. Percy suggested the filtration of the furnace gases, and, about eight years later, the suggestion was applied on a practical scale by Lewis and Bartlett by the erection of a "bag house" at Joplin, U.S.A.

Another process of special interest, by reason of its novelty and efficacy, is the Cottrell process of electro-static precipitation, which has been introduced during the last few years in several large lead-smelting works in the United States.

The literature of lead, even including papers in technical journals and valuable chapters in the leading manuals on non-ferrous metallurgy, is considerably less than that of the metals we have just considered. The first book to deal adequately and authoritatively with the metallurgy of the metal was "The Metallurgy of Lead," by Dr. Percy, published by Murray in 1870: a book which retains a permanent interest on account of the chapters containing the researches carried out in his laboratory at the Royal School of Mines on what may be termed the fire-chemistry of the metal. Besides this volume there are only two other books worthy of special note, one of which we owe to our old Firm, the House of Griffin—viz., Hofman's "Lead," published

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Author of
"An Introduction to the Study of Metallurgy,"
and many Scientific Papers.

in New York in 1892 and 1918, and the other, Collins' "Metallurgy of Lead," published by Charles Griffin & Co. in 1899 and 1910. Both are by men who have had extensive practical experience in lead-smelting and desilverisation. They are complete treatises on the metallurgy of the metal, and give clear and trustworthy accounts of all the improvements of recent years.

GRIFFIN'S FIRST IN THE FIELD ON THE LITERATURE OF GOLD.

Gold.—Gold, on account of its very wide distribution in the sands and gravels of rivers, its colour and brilliant lustre, must have been the first metal to attract and be known to man.

That it was actually mined in Egypt as early as the thirteenth century B.C., we have the evidence of a map of a mining district depicted in a papyrus of that date. The ore was then ground in querns or rude mortars, and the metal was separated from the earthy matter by washing with water.

Curiously these simple operations of the earliest times, supplemented in the middle ages by treatment with mercury in tubs and bowls, were still the only methods practised up to last century, with the exception of the introduction of stamps for crushing the ore in the early part of the sixteenth century. It was not, in fact, until about the middle of the nineteenth century that the first important improvement in the extraction of gold was made by charging mercury with the ore into the stamp battery, and placing amalgamated copper plates within the mortar, and also outside, to catch the gold.

The middle of the century is also noteworthy for a radical departure from the old-time methods—viz., the introduction of the chlorination process.

In 1848 the use of chlorine as an agent for the extraction of gold was proposed by Dr. John Percy at the Swansea meeting of the British Association. Simultaneously, Professor Plattner, Assay Master at the Royal Freiberg Smelting Works, made use of chlorine in the assay of auriferous residues, and, in 1849, on the advice of Lange, the first chlorination works was established at Reichenstein, chlorine being used in the form of gas. The process was soon widely used for the treatment of concentrate, and from about 1888 to 1912 for the treatment of suitable ores, the result being that very large amounts of gold were obtained from ores and material which could not be satisfactorily treated by stamp milling and amalgamation.

Towards the end of the century the invention of the cyanide process, the importance of which it is impossible to overestimate, marks an era in the history of gold.

In 1886 a series of experiments on wet processes of treating gold ores was begun by J. S. McArthur and R. W. and William Forest in Glasgow, and it was entirely owing to their energy and skill that potassium cyanide was successfully applied in practice to the treatment of these ores. The process known as the cyanide process was introduced at Karangahaki, New Zealand, in 1889, and near Johannesburg, in the Transvaal, in 1890. It has now passed into use in all parts of the world.

With the introduction of the cyanide process chlorination has gradually passed into disuse, and is likely soon to become obsolete. In the cyanide process the cost of chemicals and of working is comparatively low, hence it is specially suitable for low-grade ores. So great is the importance of the process in the Transvaal that without its aid few of the mines could be profitably worked, and the same is true of most of the gold fields in other parts of the world.

The gold produced by all the above-mentioned methods is always more or less impure, and has to be refined.

For this purpose the following processes have been or are in use :—

1. *Parting by Nitric Acid.*—In use in the thirteenth century, and probably earlier.

2. *Parting by Sulphuric Acid.*—First applied on the large scale in 1802 in Paris.

3. *Treatment with Chlorine.*—First proposed by Lewis Thompson in 1838.* Invented independently by F. B. Miller in 1869, who was the first to apply the process on the large scale.

4. *Treatment by Electrolysis.*—First proposed by Charles Watt, of Sydney, in 1863.†

Process 1 is obsolete, while process 2 is being displaced by 4. The treatment with chlorine, however, continues in use in Australia, where it appears to be suited to the local conditions.

As regards the literature of gold, now so extensive, it is remarkable that, until the year 1852, there was no book in our language dealing specially with its metallurgy. The credit of being the publisher of the first book on the subject belongs to the House of Griffin. In that year was issued "Gold Mining and Assaying," by

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* *Trans. Soc. Arts*, Vol. liii., Part I., p. 16.

† Rose, *Gold*, p. 474.

John Arthur Phillips, a manual prepared by that distinguished metallurgist as a scientific guide for Australian emigrants.

From that date until 1894 only two books had appeared in the English literature of the metal, "The Mining and Metallurgy of Gold and Silver," by Phillips, and "Gold: its Occurrence and Extraction," by Lock, both published by other firms.

In 1894, however, the old House again comes to the front by the issue of the masterly treatise, "The Metallurgy of Gold," by T. Kirke Rose, who has since had the honour of knighthood. In its successive editions this has been recognised as the best general treatise on the metallurgy of the metal. In fact, it is not too much to say that it is indispensable, not only to students, but also, and especially, to all who are practically engaged in the extraction and refining of gold.

The firm also deserves the congratulations of all interested in, or working on, the extraction of the precious metal for the publication of the following special works:—"The Cyanide Process of Gold Extraction," by James Park, 1900; "Cyaniding Gold and Silver Ores," by H. Forbes Julian and Edgar Smart, 1904; "Rand Metallurgical Practice," two volumes, 1911.

Professor Park was the first author to provide students with a text-book on this important process. The two last-mentioned books are, however, specially noteworthy.

When Julian and Smart's was issued there were probably no persons who required a book of reference more than those engaged in the industry of cyaniding gold and silver ores. The book is intended not only for the student or shiftman, but also for the manager and engineer, and in it are clearly set forth the principles involved in the working of the process, and in the construction and design of the plant.

In the "Rand Metallurgical Practice" we have a book written by a body of technical men engaged in current metallurgical practice on the Rand, the greatest gold field on record. It is certainly one of the most important books on metallurgical practice ever published. The operations and the plant in use in the various stages of the process are each ably described in detail by men who are actually engaged in working them; first-hand and up-to-date information is hence afforded to all who consult the work.

Silver.—The sources from which the metal is obtained are chiefly silver ores proper, lead ores in which it is always present, and, to a small extent, from copper.

The processes for its extraction, especially from its ores, have been the subject of revolutionary changes during the period under consideration.

The Mexican patio process, dating from 1557, and other time-honoured amalgamation methods by which large amounts of silver were extracted have passed away.

The European barrel process of amalgamation, which was first employed at Freiberg in 1790, has also become obsolete, although it was in use in Japan as late as 1880 for the treatment of a large accumulation of waste heaps at a disused mine.

A still later process, the Washoe or pan process, introduced in 1861 for the treatment of the vast deposits of silver ore of the famous Comstock lode has also had its day.

Of the lixiviation processes, the Augustin, the Ziervogel, and the Patera, first employed about the middle of last century, with their various modifications, are no longer in use, and are only of historical importance.

By far the most important advance in the methods of extracting silver from its ores is the introduction of the cyanide process near the close of last century, the principles of which are the same as in the treatment of gold ores. Its application to silver ores was delayed until six years after its successful application to gold ores, as it was generally considered to be attended with too many difficulties to be carried out economically on a large scale in the case of a metal of so much lower value than gold. Further, the success of pan amalgamation prevented its adoption in the United States. But in Mexico, where that process could not be conducted with profit on the low-grade silver and gold ores, which are so abundant, it was in that country, at El Oro in 1895, that the real pioneer work in the application of the cyanide process was begun. It is now in successful operation in all important silver-mining regions.

The silver obtained from lead ores or by smelting silver ores with lead ores forms, however, by far the largest proportion of the world's production of the metal. The chief features of this branch of its metallurgy are the advances made in the method of its extraction from lead already mentioned.

The literature relating to the metallurgy of the metal is but scanty. Percy's "Silver and Gold" was published in 1880, and is still a valuable book of reference for the experimental work performed in the author's laboratory on the properties of the compounds of the metal and their bearing on the principles on which its metallurgy is based. Until twenty years after its publication there was no book dealing specially and comprehensively with its metallurgy.

In 1900 the House of Griffin made good the deficiency by the issue of "The Metallurgy of Silver," by H. F. Collins, an author who had had considerable practical experience, in the metallurgy of the metal. For this, the first and only English book dealing adequately with the subject, the firm merits special commendation.

A new edition, which is in preparation, will be heartily welcomed, and should be the best treatise on the metal.

Zinc.—In the metallurgy of zinc there have been fewer radical changes than in that of the other industrial metals, yet considerable progress has been made.

No other of the common metals requires for its production such a large amount of coal per pound of metal, and the chief improvements which have been effected in Europe have been in the direction of economy in the consumption of fuel.

To this end the old coal-fired Belgian and Silesian furnaces have been combined in the modern Belgo-Silesian or Rhenish furnaces by a modification of the form and dimensions of the retorts and by the adoption of gas in the place of coal for fuel.

Further economies have resulted by the introduction of more efficient furnaces for the roasting of blende, in which mechanical rabbling has to a marked extent replaced hand labour.

The most important advance in its metallurgy during recent years, however, has been the inauguration of electrolytic zinc production direct from the ore at Northwich, and especially by the erection, in 1915, of an extensive plant at Anaconda, and others in Canada, Australia, and elsewhere. But it must not be overlooked that cheap hydroelectric power or certain other favourable conditions are essential to its commercial success, so that it can hardly displace the distillation process for the production of ordinary spelter. On the other hand, it has the great advantage of yielding a pure metal, for which there is a large and ever-increasing demand.

Another recent innovation is the application of electric smelting to zinc ores, but the cost of electrical power and its application will restrict its use to favourable localities.

The literature of the metallurgy of zinc is much less extensive than might have been expected on a metal so essential to many industries. The first treatise of any real value to the metallurgist is contained in the first volume of Percy's "Metallurgy," published in 1861.

In the chapters relating to zinc we have a clear and masterly exposition by that distinguished metallurgist not only of the principles and reactions on which the extraction of the metal depends, but also complete drawings of the furnaces employed, and comprehensive details of the manner in which they were worked at the time. Since that date there had not been published any other special treatise until 1903, when the "Metallurgy of Zinc and Cadmium" was written by Walter Renton Ingalls.

Metallurgical Practice at the present date, however, is the subject of valuable chapters on zinc in Prost's "Cours Metallurgique," and in "Zinc," by E. A. Smith, recently published, will be found an excellent *résumé* of the metallurgy of the metal. In the author's "Metallurgy of the Non-Ferrous Metals," published by Charles Griffin & Co., 1918, all the important advances now in actual practice in spelter works are dealt with.

Antimony.—Antimony, although of less extensive production and of limited application as compared with the metals already considered, is worthy of a brief notice owing to the revolutionary changes in the methods of its extraction which have been initiated and carried out, chiefly in France.

The new processes, of which there are two, were invented respectively by Chatillon and Herrenschmidt in the first decade of the present century. They consist in the volatilising-roasting of antimony sulphide, and the advantages claimed for them are—low-grade ores can be treated direct with less loss of the metal and a lower consumption of fuel than in the old liquation and iron reduction processes.

Again our old Firm distinguishes itself as a pioneer in metallurgical literature, being the publisher of "Antimony," by C. Y. Wang, the only treatise on the metal dealing with these new processes. The author has had practical experience on the working of the new processes, his description of the plants and their operation are hence specially valuable.

GRIFFIN'S TEXT-BOOKS ON ASSAYING.

Assaying.—The progress in the art and science of assaying has not been less remarkable than in the other branches of metallurgy.

"To mining men the word assaying conveys a sufficiently clear meaning, but it is difficult to define. Some writers have limited it to the determination of silver and gold, and others imagine that it has only to do with furnace work. These limitations are not recognised in practice. In fact, assaying is becoming wider in its scope, and the distinction between 'assayers' and 'analysts' will, in time, be difficult to detect."* Its methods are no longer empirical, but are based on and conducted in accordance with the principles of chemistry, an exact knowledge of which is essential to their success.

There are many books on assaying, in fact its literature is richer than that of any other branch of metallurgy. Sir T. Kirke Rose,† in his book on "Gold," enumerates no less than fifty-three books published between 1828 and 1914, of which twenty-two were published in England, seventeen in America, eight in France, and five in Germany.

Up to the middle of the century there had been no text-book on the subject in the English language, so that assayers had to refer for any information they might require to French or German works.

It is, therefore, gratifying to note that Griffin's were the first to practically fill the gap as regards gold assaying by the issue, in 1852, of "Gold Mining and Assaying," by John Arthur Phillips.

In the same year "A Manual of Practical Assaying," by W. Mitchell, was published, and, in successive editions, was the chief book in use by students and assayers until 1889, when, by far the most important book that had yet appeared, the "Text-Book on Assaying," by the late J. J. Beringer, the distinguished teacher of assaying in the Camborne School of Metalliferous Mining, was issued by Charles Griffin & Co. In its thirteenth edition it has been brought thoroughly up-to-date, and is a standard work in all parts of the world.

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* Beringer, *A Text-book of Assaying.*

† Rose, *The Metallurgy of Gold*, 1915, p. 573.

GRIFFIN'S PIONEER BOOKS.

Foundry Practice.—Iron founding may be divided into two classes—in one the foundry is only part of a large engineering works for the production of castings to supply its needs, in the other it is constructed specially for the production of castings of every kind for all who require them.

In the former case the moulding shop, as a rule, was in the first half of last century a poorly-equipped room, devoid of mechanical appliances, in which rule of thumb methods alone were employed, whilst, in the latter, the conditions and methods, although on a large scale, differed but little from those of the former.

The foundry can scarcely be said to have kept pace with the advances made in most branches of the iron and steel industry. The cupola has indeed been improved in efficiency and economy, and in the generation and supply of the blast, and machines are being introduced to save some of the labour or skill required in moulding. The chief and most important advance, however, is in the adjustment of the composition of the charges by which the physical characters which are essential for the various engineering and constructive uses for which the castings are intended are ensured. In this connection the art of founding is now passing through a transition period in which science is taking the place of empiricism.

As late as the middle of last century it was held that "the best way to try the quality of cast iron is to strike its edge with a hammer. Should the blow make a slight impression, the iron must be in some degree malleable, and, if the specimen be uniform, it may be regarded as good for machinery, if, on the contrary, the hammer makes no impression and fragments fly off, the iron is brittle, and consequently bad" (Grier).*

"Considerable importance was formerly attached to the source of the iron, the ores employed, and the temperature of the blast. It is now, however, generally recognised that these conditions are merely equivalent to certain chemical and physical properties, and so long as these properties are obtained the stages which have led up to the desired result are not in themselves important."†

At present it is held that the only true guide in estimating the value of pig iron for use in the foundry is its chemical composition. It is hence becoming customary to demand a complete analysis of all iron delivered to the foundry.

The founder should, in fact, know the composition of all the metal in his yard, and, in modern specifications, the limits permissible of the amounts of silicon, sulphur, phosphorus, and manganese present should always be stated.

But by far the most momentous advance in foundry work is the production of castings of steel direct from small converters or huge open-hearth furnaces in which the steel itself has been actually made. From the latter ponderous castings of dimensions and weight hitherto undreamt of are now being made every day.

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* Muspratt's *Chemistry as applied to the Arts and Manufactures*, ii., p. 431.

† Turner, *The Metallurgy of Iron*, p. 288.

In the literature of foundry practice our enterprising Firm has contributed the most valuable books which have been published in this country.

Of these, "General Foundry Practice," by McWilliam and Longmuir (1907), and "Cast Iron in the Light of Recent Research," by Hatfield (1908) are worthy of special mention, as they cover the whole field of practice and theory, and are written by men who are masters of their respective subjects.

Not the least in significance or far-reaching consequence in the metallurgical progress of the last half century is the application of micrography and pyrometry to the examination of the structure of metals and their alloys, and the changes effected in their physical properties when they are subjected to mechanical and heat treatment.

The application of the microscope, first applied by H. C. Sorby to the examination of metals and alloys, is now found to be indispensable for a correct understanding of their structure, and the changes resulting from their treatment in the workshop.

The pyrometer, by the researches and experiments of Chatelier, Roberts-Austen, Callender, and other distinguished workers, has become an instrument of everyday use in metallurgical and engineering works, with the result that important processes and methods of treatment formerly conducted and controlled by "rule of thumb" are now carried out with scientific accuracy.

For example, the temperatures at which castings should be made in order that they shall possess to the maximum extent the physical properties required of them, and especially the temperatures essential to the successful heat treatment and tempering of steel, can now be determined with exactness, while formerly the eye alone was relied on, and it is needless to say too often with uncertain results.

The literature of micrography and pyrometry is chiefly to be found in papers in technical journals and the *Proceedings* of Societies.

In 1904, however, it was the privilege of the Firm to publish " The Microscopic Analysis of Metals," by F. Osmond, edited by J. E. Stead. In this connection it is important to note that there had been no work previously published in English calculated to be so useful to the student in metallographic research.

During the last few years no text-book on temperature measurement had appeared in this country, and again we are indebted to the House of Griffin for remedying this want by the issue, in 1918, of " Methods of Measuring Temperature," by Ezer Griffiths, containing an excellent summary of the subject.

Refractory Materials is another subject which has been most excellently dealt with in a standard volume by A. B. Searle, whilst " Briquetting and Agglomeration of Ores, Metallurgical Products, etc.," by Prof. Franke and F. Lantsberry, must be mentioned.

GRIFFIN'S IMPORTANT CONTRIBUTION TO METALLURGICAL ADVANCE.

When we reflect on the state of metallurgy and metallurgical literature in the early part of the nineteenth century and compare it with the progress which has been made since then, we shall be convinced that the last hundred years has done more than all the centuries which have gone before in their advancement, and the firm of Charles Griffin & Co., have in no small measure contributed to that end. During this period the Firm has been especially distinguished for its valuable contributions to the literature of the principles and practice of metallurgy. No other publisher had provided the student or those engaged in the actual carrying out of metallurgical operations with such a series of important volumes in any language.

It may be remarked further that one of the most, if not the most, important part of the work of the Firm has been the production of the series of metallurgical treatises written by Associates of the Royal School of Mines, the author of each having had special practical experience in the extraction and treatment of the metal with which he deals. They became practically the publishers to the Royal School of Mines.

The first volume, " An Introduction to the Study of Metallurgy," by Roberts-Austen, who subsequently received the honour of knighthood, was published in 1890, and was the first book to appear in which the general principles of modern metallurgy are systematically treated.

The other books in the series, " Gold," by Rose (1894), " Iron," by Turner (1895), " Lead," by Collins (1899), " Silver," by Collins (1900), " Steel," by Harbord (1903), have already been commented on.

The subsequent additions to the series are " Alloys," by E. F. Law (1809), " Sampling and Assay of the Precious

Metals," by E. A. Smith (1913), "The Metallurgy of the Non-Ferrous Metals," by W. Gowland (1914).

A valuable and important feature of the series is that each book is being kept up-to-date by successive editions, in which the most recent advances in metallurgical progress are dealt with.

During the last quarter of the century, under the able guidance of Mr. Francis J. Blight, F.R.S.E., the House of Charles Griffin & Co., Ltd., has specially distinguished itself by the publication of more notable books than at any period in its history, and now, at the end of its first century, it exhibits greater vigour than ever before.

In conclusion, I may be permitted to quote from Dr. Percy's introductory lecture at the foundation of the Royal School of Mines in 1852, "in proportion to the success with which the metallurgic art is practised in this country, will the interests of the whole population, directly or indirectly, in no small degree be promoted."

Professor HENRY LOUIS, M.A., D.Sc.

Chapter VIII.

GRIFFIN'S PUBLICATIONS (1820-1920) IN MINING, PETROLEUM AND GEOLOGY.

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Mining Engineering (a " Key Industry")—Complexity of the Subject—Training necessary in all Cognate Branches of Science and Technology—The Royal School of Mines—Department of Science and Art—Science Examinations—British Mining Literature—Griffin's First in the Field—Standard Books of Great Excellence—Practically Publishers to the Royal School of Mines—Sir Clement Le Neve Foster, Herbert W. Hughes, S. Herbert Cox, Bennett H. Brough, J. Gunson Lawn, and others—Mining Specialists—*i.e.*, Prof. James Park, George L. Kerr, Dr. J. Scott Haldane, Sir John Cadman—Petroleum—Sir Boverton Redwood, Bart.—Other Leading Authorities—Geology with Direct Reference to Mining—A Tribute of Respect to Griffin's.

Chapter VIII.

MINING, PETROLEUM AND GEOLOGY.

GENERAL CONSIDERATIONS.

THE fact that the publication of technological text-books on any subject must depend essentially on the development of education in that particular branch of technology is sufficiently obvious, and the subject of mining forms an admirable illustration of this statement. Of all the multifarious branches of engineering, it must, I fear, be admitted that mining is to-day and will, perhaps, always remain the least scientific and the most empirical; whilst most of the other sub-divisions of engineering have by this time been placed upon a sound mathematical basis, the data for which have been derived from careful experiments and close investigations, the mining engineer has still to rely very largely upon records of observations, and has to use rule of thumb where the other departments of the art can apply definite formulas. To some extent this is due to the great complexity of the subject and to its ever varying conditions, each mine presenting, in fact, its own particular problems and difficulties, which no other mine exactly reproduces. Furthermore, there is no other branch of engineering in which it is so utterly impossible to determine by experiment the data that would be required for anything like an exact solution of the mining engineer's problems, whilst there is none that is so absolutely dependent upon natural occurrences; the mechanical engineer, for instance, can fashion his machines as he will, and can calculate beforehand the exact effect of each component element; the mining engineer must take his mineral deposits as he finds them, and must endeavour to adapt his methods from day to day to changing conditions which he can neither foresee nor control. Hence it is that mining, perhaps the oldest form of technology, is still the most backward in strict scientific development, and it must be admitted that, for the same reasons, the study of the subject still involves essentially descriptive rather than rational methods, and is on this account of distinctly lower educational value than any of the other branches of engineering. As I have had occasion to point out more than once, the subject that need occupy the least part of the time of a mining student is that of mining; it is more important to him to be thoroughly trained in all the cognate branches of science and technology, their application to the solution of mining problems coming later, and being then a relatively easy matter. The mechanical engineer, the electrician or the surveyor, who is fairly familiar with his own subject can readily enough apply such knowledge in the mine, but no mining engineer can be considered thoroughly qualified for his task unless he has a sound knowledge of these, and, indeed, of most other branches of engineering technology. The services of a publisher to the student of mining are therefore not limited to the production of works on mining alone; it is not too much to state that there is hardly a single book in the whole long list of Messrs. Griffin & Company's technical publications that the mining engineer will not have occasion to consult at some stage or other of his professional career.

Early Mining Literature.

In reviewing mining literature in the narrower sense of the word, the most striking fact about it is that it, together, of course, with education in mining technology, is a plant of very recent growth. As far as I know, the first systematic attempt to teach the subject of mining was made by the University of Durham, which established a course in Civil Engineering and Mining as far back as 1837. The attempt did not meet with any great measure of success; it was, however, followed, after a long interval, by a similar course at what was then known as the Newcastle-on-Tyne College of Physical Science in 1852, and this latter has left its mark in mining literature, as the lecturer, Mr. J. C. Greenwell, a well-known North-country colliery viewer, published the substance of his lectures in a book "A Practical Treatise of Mine Engineering," which I believe to have been the first real mining text-book written in English; I am excluding, of course, such quaint books as Hopkin's "Conversations on Mining," which hardly rank as text-books. Greenwell's book was, however, mainly of local value, and nothing effective was done towards the teaching of mining engineering in this country until the Royal School of Mines, or, as it was originally called, the Government School of Mines and of Science Applied to the Arts, was opened in 1851.

THE ROYAL SCHOOL OF MINES—DEPARTMENT OF SCIENCE AND ART, SOUTH KENSINGTON.

This may fairly be described as the commencement of the systematic teaching of mining in this country, and the debt of the mining engineer to Sir Henry De la Beche, through whose efforts the school was founded, should never be forgotten; at the present moment when the great importance of the mining industry to the British Empire as a whole is beginning to attract the attention that it merits, it is interesting to recall a sentence in De la Beche's opening address, which runs as follows:—

> "It has been deemed expedient to extend the lectures so as to embrace instruction of a character resembling that given in foreign schools of mines, and, while it should be adjusted to the wants of this country, should also have reference to the mineral wealth of the Empire at large."

It is interesting to look back to-day and to see that already, at the inception of the Royal School of Mines, the imperial idea was in the thoughts of its founders. Although the opening of this school may fairly be taken as the starting point of mining education in this country, teaching in general technology had already made some headway. The Birkbeck Institution had indeed commenced an attempt to popularise the teaching of science about half a century before this date, but Birkbeck was before his age, and his work can hardly be said to have had any lasting effect on the educational methods of the nation. In 1843 the Board of Trade had created a School of Design, and, some ten years later, science subjects were added, the department entrusted with this work being then known as the Department of Science and Art, which was transferred from the Board of Trade to the Committee of the Privy Council on Education about 1856. A system of science examinations was inaugurated by the Department in 1863 with six subjects, all essentially pure science, and these roused an interest in the teaching of science throughout the country. In 1861 the list of subjects had increased considerably, and was divided into several groups, one of which comprised the subjects of geology and mineralogy; in 1862 the latter subject was entitled mineralogy and mining, and, in 1863, mining and, incidentally also, metallurgy, formed separate subjects, the number of the latter having by this time been increased to 17. The interest taken in these examinations led to the foundation of numerous institutions in which the teaching of technology commenced throughout the country. Several such institutions, especially in the mining districts, like the Miners' Association of Devon and Cornwall, commenced the teaching of mining. With the development of mining classes, a demand for mining text-books arose, and this may fairly be considered the commencement of British mining literature. It need hardly be said that the 1872 Coal Mines Act, which called for the management of collieries by certified managers, and instituted examinations of proficiency for the necessary certificates, added a further powerful stimulus to mining education and to mining literature, at any rate as far as concerns coal mining; it is undoubtedly due to this Act that English books on coal mining so greatly out-number those on metalliferous mining, and it is, furthermore, due to the fact that in this country coal mining and metalliferous mining are subject to entirely different legal enactments that has caused a corresponding split in our mining literature, the consequences of which are to some extent unfortunate, seeing that they have prevented the publication of any comprehensive work dealing with the subject of mining as a whole, though this is undoubtedly the most scientific way of looking upon the subject.

The mining student of to-day, with an almost bewildering wealth of technical literature at his disposal, has but little conception of the difficulties that beset the student of half a century ago. In my student days I do not recollect a single text-book dealing with metalliferous mining except a very slight sketchy booklet written in 1874 by the late J. H. Collins essentially for the elementary stage of the South Kensington examinations of the Science and Art Department. In coal mining we had a small elementary work by Sir Warington Smyth, which was a mere sketch of the subject, though it was written with the admirable lucidity that characterised all his work. Sir Warington never wrote any general text-book on mining, although his well-known lectures at the Royal School of Mines have formed the basis and the inspiration of a great portion of British mining education. These lectures were, however, printed at some length in the *Mining Journal* of 1875 and 1876, though I believe that Sir Warington Smyth had nothing to do directly with this publication. It is worth putting on record that they were reprinted in 1881 at Tokio by the Japanese Imperial College of Engineering, under the auspices of the Professor of

Mining, Dr. John Milne, who prefixed the following note to this reprint :—

> "These lectures are intended for the use of the Mining Students in the Imperial College of Engineering who have hitherto been without text-books in which mining operations were treated of generally. They were printed at the private press of the college, and they are intended for private circulation."

GRIFFIN'S PIONEER BOOKS FOR MINERS.

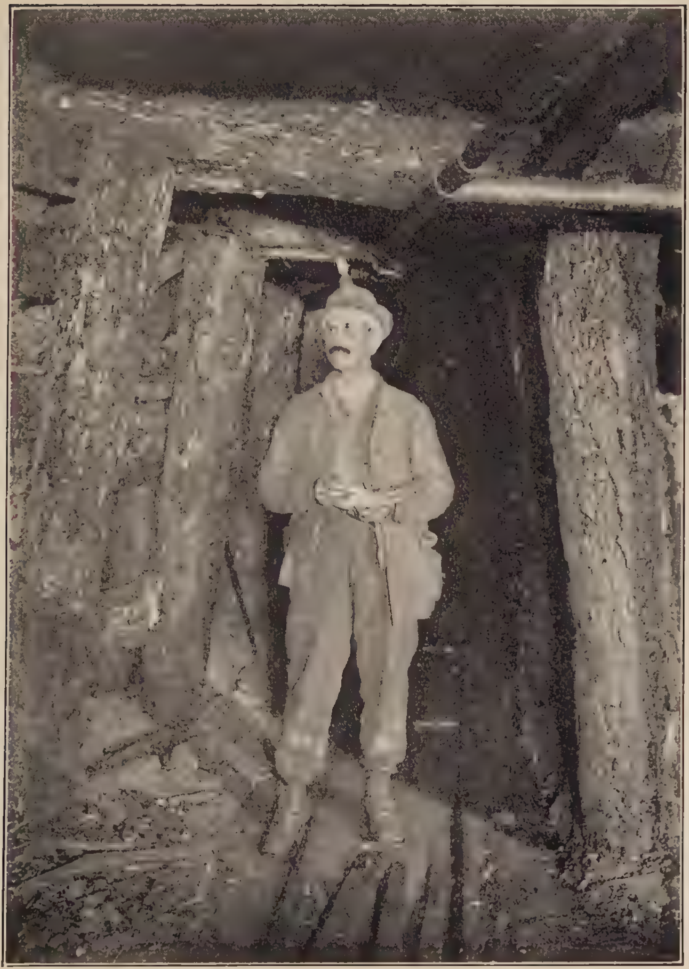
Thus, even at this relatively late date, although a quarter of a century has elapsed since the Royal School of Mines was founded, there was no such thing as a recognised English text-book of mining. In fact, it may fairly be said that this continued to be the position until Messrs. Griffin & Company had the courage to enter the field and to commence the issue of their series of mining text-books ; the acumen in perceiving the want and the enterprise in filling it displayed by this firm cannot be too highly commended, and entitles them to the gratitude of students, and certainly, in no lesser measure, of teachers of mining. The publisher of technological works has to face difficulties that apply to no other type of publication. Literary works are never out of date—Shakespeare is read even to-day ! Works on pure science enjoy a comparatively long lease of life, because, however much views and opinions may change or new methods and theories may develop, the ground-work remains unaltered, and sound principles maintain their position ; the works and writings of such an author as Lyell, for instance, will remain standard works, and will continue to be read whatever advances may be made in the science of Geology. Mathematical books are notoriously long-lived, and may run through scores of editions without alterations; a technical text-book, on the other hand, is almost out of date before the manuscript can be published, not because publishers are slow, but because new methods, new inventions, and new applications come forward with such rapidity in every progressive industry, thanks to the fertile genius of the leaders among our technologists. The publisher of technical works must, therefore, make up his mind to deal with comparatively small editions, and has, furthermore, to make arrangements to ensure that successive new editions shall be kept constantly abreast of the industry. It is no easy task to find men who can accomplish this successfully, who are able to incorporate new material without destroying the individuality and the orderly sequence of the original work, and, above all, to determine what should be discarded, because the progress of the art in certain directions may have caused certain matter to become more or less obsolete. All this adds materially to the labour and cost of production, whilst a book on a descriptive subject like mining is useless without numerous and carefully executed illustrations. All the more honour, therefore, to a firm which has specialised in publishing technological works, and has set itself the task of producing and maintaining them at the high standard of excellence for which Messrs. Griffin & Company have earned a well deserved reputation. The first essential is, of course, to find engineers of first-rate ability and experience willing to undertake the labours of authorship, and in this respect

Messrs. Griffin & Company have been exceptionally fortunate, all their more important works being from the pens of men of acknowledged eminence in their professions. As an old student of the Royal School of Mines, I feel some pride in pointing out how large a proportion of these writers are Associates of that School, thus emphasising from a new standpoint my previous contention that the foundation of the Royal School of Mines was the real origin of British mining literature.

Practically Publishers to the R.S.M.

One of the first of these mining text-books, and still one of the very best, is the "Text-book of Coal Mining," by Herbert William Hughes, A.R.S.M., originally published in 1892, and now in its sixth edition. Mr. Hughes took his Associateship in the Royal School of Mines in 1884, and forthwith devoted himself to coal mining; he became mining engineer to the Earl of Dudley's Collieries in 1889, and in the same year commenced to deliver a course of lectures on mining at the Masons Science College at Birmingham, which lectures formed the foundation of his book. He is now, and has been for many years, general manager of Sandwell Park Colliery. In spite of the multifarious duties that devolve upon the manager of a great colliery undertaking, and which have been so greatly increased by the coal mining legislation of recent years, Mr. Hughes still finds time to revise carefully each new edition and to keep it thoroughly up-to-date. What this involves is only known to mining engineers who have followed the extensive changes in colliery practice that have taken place since the first edition was issued; to mention only a few—mechanical coal cutters, face conveyors, electric winding and the electrification of colliery plant generally—all fall within this period, and these alone imply alterations in every item of coal production. There are few industries in which technical advance is more rapid or in which greater keenness is shown to adapt to the specific needs of the industry every new invention that is brought out. Furthermore, the vast changes in the attitude of labour during the last four years alone will render all older systems of costs quite useless, and will profoundly modify the economics of coal mining. These are only examples of the work involved in keeping such a book up-to-date, and maintaining its usefulness to the student, which it necessarily will have to do in order to retain its pride of place as the leading work on coal mining in the English language.

Two years after the publication of the last-named book—namely, in 1894—Sir Clement Le Neve Foster published his work, "Ore and Stone Mining," the standard book, indeed almost the only book, on the subject in our language, which is known and used in every mining region of the English-speaking world. Not only does it contain a wealth of carefully collected information, but it is written with the lucidity and charm of style which all who knew him always associated with the author's intensely attractive personality. Sir Clement Le Neve Foster took his Associateship of the Royal School of Mines in 1859, and, after serving for a few years on the Geological Survey, went abroad, and had experience of mining in various parts of the world. In 1873 he was appointed Inspector of Mines, and, in 1890, he succeeded



Sir C. Le Neve Foster, D.Sc., F.R.S.,
Author of
"Ore and Stone Mining," and "The Elements of Mining and Quarrying."

Sir Warington W. Smyth in the Chair of Mining at the Royal School of Mines. He had previously, in 1876, in collaboration with his friend and former colleague, Dr. William Galloway, translated Callon's "Lectures on Mining" into English, but the book was never popular in this country. There is little doubt but that this work exercised a considerable influence upon Le Neve Foster's own views, and possibly induced him to adopt in his own book on "Ore and Stone Mining" a sub-division of the subject markedly different from that which had been followed by Sir Warington W. Smyth. Thus, instead of dividing his subjects under the heads of drifts, shafts, stopes, etc., he treats separately of the methods of excavating each of these forms of working and of the methods of securing them by means of timber, iron and masonry. Each system has its advantages and its drawbacks, but I am bound to own my preference for the first-named, which I always use myself, though I admit that, in part, this may be ingrained prejudice, as it implies adherence to the system that Sir Warington W. Smyth adopted in his lectures at the Royal School of Mines. I undoubtedly find that it appears to be easier to the student and to lend itself better to the full discussion of economic considerations. This is, however, entirely a matter of opinion, and my own views do not prevent my using "Ore and Stone Mining" as my accepted text-book on the subject. Since Le Neve Foster's death, brought on, as many will remember, by his devotion to his duty as inspector in going down a mine that had taken fire, the more recent editions have been revised by Professor S. H. Cox, A.R.S.M., who succeeded Le Neve Foster in the Chair of Mining at the Royal School of Mines, and who has kept the work fairly abreast of modern practice.

Messrs. Griffin & Company also publish another book by Sir Clement Le Neve Foster, "The Elements of Mining and Quarrying," described by the author himself as an introductory text-book for mining students. It does not profess to be in any way a complete treatise on the subject, but aims at presenting an outline that may serve the student as an introduction to more detailed works, and may enable the general reader to familiarise himself with the broad principles on which mining operations are conducted. It need only be said that in style and attractiveness it is quite equal to the larger work; as most of those who have tried it will be well aware, it is a far more difficult task to write a good small book than a large one upon so complex a subject as mining, and it is a tribute to Le Neve Foster's marked ability that he has succeeded in compressing so much useful information into so small a volume.

Griffin's Mining Series Extended.

Messrs. Griffin's list includes two other works on mining strictly so-called, both from the pen of Mr. George L. Kerr, a well-known Scotch Colliery Engineer and Secretary to the Mining Institute of Scotland. One of these is a small text-book called "Elementary Coal Mining," first published in 1902, and intended only for lads who desire, for some reason or other, to obtain an elementary insight into coal mining methods. The other work, which is on far more important lines, called "Practical Coal Mining," was first published in 1900. It is especially valuable because Scotch colliery practice is here fully and clearly described. It is, perhaps, needless to say that though the principles are everywhere nearly the same, the details of colliery working differ widely in different parts of the country, even the phraseology of one district being unintelligible in another, so that a study of no one district, however important, is sufficient to give a thorough understanding of British coal mining methods. Thus, it is that the works of Mr. Kerr and Mr. Hughes are in a great measure complementary, and that both must find a place in the library of the colliery engineer who desires to cover his subject at all completely. Thus, to quote one example only, whereas in Hughes' work the rectangular shaft is barely alluded to, in Kerr's book the methods of sinking and securing such shafts are given in the fullest detail, the reason, of course, being that rectangular shafts are practically unknown in modern colliery practice south of the Tweed, but are very extensively used in Scotland.

These are the only works on mining, properly speaking, but two other books deserve mention, inasmuch as each is devoted to a branch of the miner's art—namely, one on prospecting and one on sinking. Professor S. H. Cox took his Associateship of the Royal School of Mines in 1874, and immediately proceeded to New Zealand, where he held the post of Inspector of Mines until he returned to this country in 1891, where he practised as a consulting engineer; in 1905, as already stated, he succeeded Le Neve Foster as Professor of Mining at the Royal School of Mines. He published his book on "Prospecting for Minerals" in 1898, since when it has passed through six editions, thus proving how admirably adapted it is for the purpose for which it was written, that, namely, of providing within small compass a compendium of useful information for prospectors. The ordinary prospector cannot carry a large library about with him; his work entails arduous travel in the remote corners of the earth, and he has to move encumbered by as little baggage as possible, and hence it is important for him to get all the technical knowledge he is likely to need in the smallest possible volume, an object that the author has attained with marked success in the work in question. The other work, "Shaft Sinking in Difficult Places," is a translation by Mr. J. W. Brough of a German work written by Mr. J. Riemer, of the well-known firm of Haniel & Lueg, of Düsseldorf, who had specialised in the manufacture of plant and tubbing for sinking purposes; the original was written in 1905, the translation appearing in 1907. Although it is already comparatively old for a work of this description, which purposes to deal only with the most up-to-date methods of attacking a problem which always presents grave difficulties, and though it does not, for instance, make any mention of the most modern of these methods—namely, that of cementation—it is nevertheless well worth consulting by mining engineers who are contemplating sinkings in heavily-watered grounds.

Brough's "Mine Surveying"—A Classic.

Turning next to the important subject of mine surveying, we come to one of the most successful books that Messrs. Griffin & Company have ever published, "A Treatise on Mine Surveying," by Bennett H. Brough, A.R.S.M. Mr. Brough took his Associateship of the Royal School of Mines in 1881, and in the following year was appointed assistant to Sir Warington W. Smyth at the school. In 1886 he was given a more independent post, being appointed Instructor in Mine Surveying, and two years later he published his excellent little treatise, the value of which was at once acknowledged on all sides, whilst it is still to-day the leading work on the subject, being now in its fourteenth edition. In 1893 Brough was appointed Secretary of the Iron and Steel Institute, a post for which he was admirably adapted, and which was undoubtedly much more congenial to him than that of Instructor in Mine Surveying, and the duties of which he discharged, until his too early death, with a tact and efficiency that won the sincere regard of every member of the Institute. As long as he remained at the School of Mines he was able to keep in touch with all the advances of the art of surveying, and he was careful that the successive editions of his book kept abreast of the practice of the day. After his transfer to the Iron and Steel Institute, he had necessarily to devote his full energies to the duties of his office, and it must be admitted that his book suffered in consequence, and that many of the subsequent editions were little more than reprints of the previous ones. At the time of his death, the book had dropped distinctly behind current surveying practice, but fortunately Messrs. Griffin & Company entrusted its revision to Mr. Harry Dean, M.Sc., A.R.S.M., lecturer in Mine Surveying at Armstrong College, Newcastle-on-Tyne, a surveyor of exceptional skill and experience, who has brought the fourteenth edition thoroughly up-to-date, and has spared no pains to make the latest edition thoroughly worthy of the high reputation that the earlier ones had so deservedly acquired. Another valuable little book bearing on the same subject is one by Mr. Henry Briggs, M.Sc., on the "Effects of Errors in Surveying," a work in which the principles of the theory of errors are applied specifically to surveying problems; the latter are there subjected to a mathematical analysis with the object of showing how errors in surveying may be minimised and their effects guarded against. It must be admitted that this very useful little book is not intended solely or even specially for mine surveyors, but it will be as useful to them as to all others who practice any branch of the art of surveying. The same may be said of "Theodolite Surveying and Levelling," by Professor James Park, of the Otago University School of Mines, and also of "Practical Surveying and Field Work," by Victor J. Salmon, of Johannesburg, although the latter volume is particularly useful for mining engineers practising in the Transvaal, as it gives a description of South African methods of surveying and plotting surveys, together with the solutions of a number of problems set in the examinations for qualification as surveyor in the Colonies.

The economic aspect of mining has also had due attention paid to it, and Griffin's Mining Series contains a number of works dealing with this branch of the subject, amongst which the first place may fairly be given to "Mine Accounts and Mining Book-keeping," by J. G. Lawn, A.R.S.M.; this gentleman took his Associateship in 1891, was appointed Instructor in Mine Surveying at the Royal School of Mines in the following year, and, in 1896, went out to South Africa as Professor of Mining in the South African School of Mines. His book was published in 1897, after he had gained some experience of the excellent systems of costing developed in the Gold Mines of the Transvaal, and has admirably fulfilled the object for which it was written, being now in its seventh edition. In this group of works mention should also be made of "Modern Mine Valuation," by Mr. H. Burnham, whose experience as Inspector of Mines in the Transvaal has been of especial use to him in the task of authorship. "Mining Laws of the British Empire," by Charles J. Alford, and the "Mining Engineers' Report Book," by Edwin R. Field, are two other works which mining engineers may well have occasion to consult. "A Dictionary of Spanish, Spanish-American, Portuguese and Portuguese-American, Mining and Metallurgical and Allied Terms," by Edward Halse, A.R.S.M., may also be ranked here by reason of its value to English mining engineers who may be called upon to deal with mines or mineral properties in Spanish- or Portuguese-speaking countries.

A PRACTICAL HANDBOOK ON BLASTING.

Obviously enough again, the mining engineer has to be thoroughly acquainted with the use of explosives, and here also Messrs. Griffin & Company have come to his aid with two works on the subject—namely, "Blasting and the Use of Explosives," by Oscar Guttmann, and the translation by Alex. Larsen of the "Work of Testing Explosives," by E. E. Bischel. Mr. Guttmann was well known as one of our foremost authorities on the subject he here deals with, and to the knowledge of which he has contributed so extensively; his writings upon gun-powder and other explosives still rank among the standard works on the subject.

THE AIR OF MINES AND SAFETY APPLIANCES.

Next in order, perhaps, reference may be made to a series of works treating of subjects of the utmost importance to the mining engineer, some, indeed, practically indispensable to him ; they admit of no very definite classification in a review of mining literature, but are certainly none the less important on that account. The foremost place should unquestionably be given to the subjects that affect the health of the mine worker, and in this category must be placed two works, upon the title page of each of which appears the name of J. Scott Haldane, M.D. It is unnecessary to say anything as to the merits of Dr. Haldane's work, his name being familiar wherever the scientific study of mining is pursued. He has made the physiology of the miner his especial study, and it is not too much to say that he has done more for the sanitation of mining than any other man living to-day. In his first book, "Methods of Air Analysis," he gives a full account of the various methods that may be employed in examining the air of mines and of the tests which large experience has shown to be the best adapted to detect the presence of dangerous impurities. Another book on the Air of Mines in which Dr. Haldane has for his collaborator one of our most distinguished authorities, Sir John Cadman, K.C.M.G., D.Sc., Professor of Mining in the University of Birmingham, is to appear shortly, and is eagerly expected. Many other books of a more miscellaneous character may be included, such as works on the Application of Electricity to the Purposes of Mining, a branch that has made great strides in recent times, the important subject of the

Sir BOVERTON REDWOOD, Bart., D.Sc., F.R.S.E.,
Author of
"A Treatise on Petroleum" and other works.

Use of Compressed Air in mining, and on Hydraulic Engineering, especially as applied to mining; here it need only be said that each one of these subjects is of first-rate importance to the mining engineer.

PETROLEUM.

The importance of petroleum and other mineral oils has been gaining ever-increasing recognition of recent years; the production of these is necessarily a separate branch of mining engineering, and includes an exceedingly wide range of science and technology, covering as it does the art of drilling as well as the storage, transport, and the refining of the crude products; the oil-shale industry approaches even more closely to the ordinary work of the mining engineer. Messrs. Griffin & Company have published a series of treatises upon all the various aspects of the oil industry, and here again they showed their good judgment in securing the valuable services of the late Sir Boverton Redwood, Bart., D.Sc., in the early days of his career, and of other writers who specialised upon the subject. Sir Boverton became indisputably the foremost authority on petroleum in the world, and his treatise on "Petroleum" did much to extend the industry. His work was first issued in 1895, and one of the author's greatest difficulties must have been compression within manageable limits of the mass of information upon the subject which he had at his command. In this respect, with his accustomed graciousness, he acknowledged his indebtedness to the assistance of the late Mr. Geo. T. Holloway, A.R.C.Sc., who, though not in any sense a specialist in petroleum, was a scientist of marked practical ability. This was a thoroughly comprehensive treatise in which the author's extensive theoretical and practical knowledge was evident throughout, and from the first was accepted as the standard book upon the subject. For the revision of later editions Sir Boverton associated with himself other specialists, and the work has become an encyclopædia of knowledge upon every phase of the subject. At the time of his death the author had just completed a thorough revision for a fourth edition, which will be published shortly, and will prove a lasting monument to his memory.

Another excellent work is "A Handbook on Petroleum for Inspectors under the Petroleum Acts," by Captain J. H. Thompson, H.M. Chief Inspector of Explosives, and Sir Boverton Redwood, the last edition having been revised by Sir Boverton Redwood and Major A. Cooper-Key, C.B., now H.M. Chief Inspector of Explosives. Another book of recognised value is "The Petroleum Technologist's Pocket Book," by Sir Boverton Redwood and Mr. Arthur Eastlake, a small work containing within its compass most of the tabular, statistical, and similar information that a man engaged in any branch of the petroleum industry is likely to need. Although a certain amount of information on the testing of petroleum is contained in the works already referred to, and a standard work on the subject by E. Lawson Lomax, M.Sc., is announced, chemists engaged in this branch of the work will gladly avail themselves of "The Laboratory Book of Mineral Oil Testing," by J. A. Hicks, chemist to Sir Boverton Redwood, in which the accepted tests for mineral oil are fully detailed. "Petroleum Refining," by Andrew Cunningham, is an exhaustive treatise which Sir Boverton Redwood pronounced to be indispensable, and it has taken its place as the standard book of reference on this phase of the subject. A companion work on "The Chemical Nature of Petroleum," by A. E. Dunstan, D.Sc., will shortly appear. Finally, reference may be made to a very recent work by several contributors, "A Treatise on British Mineral Oil," which was written on the invitation of Charles Griffin & Company, and to Mr. J. Arthur Greene credit is given for the manner in which the collaboration was carried out. Sir Boverton Redwood himself wrote the Foreword, probably about the last thing that this eminent specialist ever published, as he died a few days after writing it, and a brief memorial tribute to Sir Boverton follows his Foreword. Well-known authorities on the subject, such as E. H. Cunningham-Craig, A. E. Dunstan, and F. Mollwo Perkin deal with different aspects of the possibility of producing oil in Great Britain. In fact, it may be said to be an unofficial record of the labours of the Petroleum Research Department, of which Sir Boverton Redwood was the head. As will be evident from what has been said, Messrs. Griffin & Company have practically monopolised the production of petroleum literature in this country and thus provided a storehouse of valuable information, ready to be drawn upon when, during the recent war, the country's want of oil fuel ranked amongst our greatest difficulties, needed as it was for the transport of troops, munitions of war, foodstuffs, and many similar purposes. Lord Moulton in the Rede Lecture for 1919, "Science and War," has well emphasised the importance of the internal combustion engine and the part that it has played in the war in motor transport, tractors, tanks, aeroplanes, and in the navy generally.

GEOLOGY FOR MINING STUDENTS.

The science upon which mining is more particularly dependent, and with which it is the most closely related, is geology; it may, indeed, be remembered that the science of geology had its origin in the needs and out of the observations of men who sought for mineral wealth underground. It was, therefore, only to be expected that Messrs. Griffin & Company should include a number of geological works among their more strictly mining publications, and of these it need only be said that they have been carefully selected with regard to the peculiar requirements of the mining engineer, and cover well the entire field of his study. The most purely scientific of these books is perhaps "Stratigraphical Geology and Palæontology" by Robert Etheridge, the distinguished author having been Palæontologist to the Geological Survey and to the British Museum, and lecturer of Palæontology for a number of years at the Royal School of Mines. In some of the other works a more marked tendency towards the practical and economic side of the science may be noted, as, for example, two books by Prof. Grenville A. J. Cole, "Aids in Practical Geology," and "Open-Air Studies in Geology." Professor Cole was a student at the Royal School of Mines in 1876; though he did not proceed to the Associateship, he was appointed Demonstrator in Geology at the Royal School of Mines in 1878 and Professor of Geology at Dublin in 1890, the year in which he published the first-named of the above books. Still more strictly applicable to the work of the mining engineer is Professor Park's "Mining Geology," a book devoted mainly to the geology of mineral deposits. The problems originated by the famous auriferous deposits of the Witwatersrand necessarily require consideration in this connection, and they have been exhaustively discussed in "The Gold Deposits of the Rand," by Dr. C. Baring Horwood, A.R.S.M., a scientifically trained mining engineer, who has had many years experience in gold mining on the Rand, and has devoted particular attention to the study of the mode of origin of the well-known Banket deposits. This is a subject that has given rise to much discussion amongst mining geologists, and various divergent views have been expressed upon it. Whatever may be the opinions held as to Dr. Horwood's solution of this highly controversial question, no one can deny that he has brought an immense amount of careful and industrious research to bear upon it, and the wealth of scientific data that he has accumulated and that will be found within the pages of this book, can certainly not be ignored by any future student of the theories of gold deposition. Mention may also be made here of the work entitled "Getting Gold," by J. C. F. Johnson, a small but essentially practical book, which has proved of the greatest service to Australasian gold miners, as is evidenced by the many editions called for.

A TRIBUTE OF RESPECT.

The above review does not pretend to be a catalogue of Griffin's mining books, but it is to be hoped that it will suffice to indicate the range of their publications, and to demonstrate how amply the needs of the mining engineer have been catered for. The events of the last few years have brought home to most people how utterly dependent we in this island are upon our mining industry, which is pre-eminently the key industry of the whole nation, to which we are, in fact, indebted for our national existence. No less, perhaps, has the importance of scientific work in all branches of technology been impressed upon the public mind, the value of scientific training in technical pursuits being at last generally recognised, though it is a painful thought that it has needed such a catastrophe as the World War to force this elementary fact upon the perception of the British public. No time would appear to be more suitable than the present for putting on record the achievements of a firm whose publications have been so helpful in the directions above indicated, in that they have contributed so largely to the diffusion of scientific information of the highest order amongst the mining engineers of the Empire, and the writer is happy to be able to pay his tribute of respect to Messrs. Charles Griffin & Company and its esteemed Chairman and Managing Director, Mr. Francis J. Blight, F.R.S.E., whose enterprise and steadfast perseverance has rendered such signal services to the mining profession.

HERBERT H. HODGSON, M.A., B.Sc.

Chapter IX.

CHEMICAL TECHNOLOGY.

By **Herbert H. Hodgson**, M.A., B.Sc., Ph.D., F.I.C., Head of the Dept. of Coal Tar Colour Chemistry, The Technical College, Huddersfield; formerly Head of the Chemical Dept., Northern Polytechnic Inst., London; late Chief Chemist for Messrs. Brotherton & Co. at their Birmingham and Stourton Works.

The Romance of Applied Chemistry—In 1820 France Leading, Scotland and England well to the fore, and Germany far behind—Parallel Progress of Science and Technical Literature—Griffin's Splendid Service and the Nation's Debt to them—Industrial Chemistry: Ceramics, Enamels, Cyanide, Sulphuric Acid, Soda, Chlorine, Bromine, Oleum, Hydrogen, The Gas Mantle, Metal Filament, Fixation of Nitrogen, Calcium Carbide, Potash, Explosives, Mustard Gas, Artificial Silk, Viscose and Bakelite, &c.—Fermentation—Synthetic Organic Chemistry—Dyestuffs—Artificial Drugs and Perfumes—The Rubber Industry—Colloidal Chemistry—Glue and Gelatine, &c.—Treatment of Effluents.

Chapter IX.

CHEMICAL TECHNOLOGY.

THE genesis and early history of applied chemistry has been most vividly depicted by Sir William Pope in his presidential address to the Chemical Society in 1918, entitled " The Future of Pure and Applied Chemistry." Sir William unfolds a romance, the parallel of which cannot be found elsewhere throughout the pages of history, and his opening question brings into striking contrast the event political with all its superficial popularity, and the event scientific which occurs almost unnoticed, but, in effect, is none the less profound. " So accustomed are we to routine habits of thought," says Pope, " that most of us would probably answer, in reply to a suddenly posed question, that the battle of Trafalgar was the most pregnant event of the first quarter of the nineteenth century. Yet a brief moment of reflection would lead us to correct this hasty statement."

During the first few years of the nineteenth century Dalton enunciated the atomic theory, Thomas Young stated the undulatory theory of light, and James Watt invented the steam engine; by these events all the amenities of human life have been revolutionised, and they have exercised vastly more influence on the well-being of the race than did the Napoleonic wars.

Sodium, which was isolated by Davy in 1807, has led, in later years, to the production of sodamide, which is the prime agent in making artificial indigo an economic possibility, while the discovery of benzene, in 1823, by Faraday, and its later separation from coal-tar by Hofmann and Mansfield was the source of the thousands of synthetic colouring matters foreshadowed by the advent of Perkin's mauve in 1856. The first practical process for making aluminium depended on the use of Davy's sodium, and, with the aid of Davy's safety lamp, 250,000,000 tons of coal are mined annually in Great Britain with comparatively slight risk. Faraday's early investigations on the chemical aspects of electrolysis and his studies on magnetic induction led immediately to the invention of the dynamo, and, through Clerk Maxwell, to the introduction of wireless telegraphy; this one branch of Faraday's investigations constitutes the ground-work of the whole stupendous vista of results of the general introduction of the electric current into modern life. Cavendish, who first produced nitric acid by the passage of electric sparks through air, was the forerunner of those large-scale operations which furnished Central Europe with the necessary nitric acid for making a long war possible.

Chemical technology in the modern sense began, therefore, in those early years of the nineteenth century which were so fertile in events of international importance, and it is interesting to note that those self-same years witnessed the foundation of Messrs. Charles Griffin & Co., the largest technical publishers of to-day, whose subsequent career has justly earned for them the name of "Makers of Modern Technology." How valuable their contribution has been to the marvellous progress of applied chemical science will be seen in the present chapter, which aims at giving a rapid sketch of outstanding chemical triumphs during the past hundred years.

Britishers acquainted with the thoroughness of German scientific literature must rejoice that, in their own language, a like efficiency had been maintained by Messrs. Griffin for a longer period, and the nation owes a debt of gratitude to these publishers of books relating to applied science for the remarkably disinterested part they have taken in making available the results achieved by the vast international army of scientific workers, whose labours have thus been made of permanent value by their preservation in book form.

The whole fabric of modern civilisation is now interlaced with the endless ramifications of applied chemistry, but those following the trend of present-day activities will be interested to know that the lusty career of industrial chemistry was inaugurated in France during the Continental Blockade of the Napoleonic wars. The starting-point was Leblanc's method for the manufacture of soda as a substitute for the imported alkalies whose supply had been cut off, followed by Berthollet's process for bleaching with chlorine, and beet sugar cultivation for replacing Colonial cane sugar.

First successes stimulated new endeavours, and small wonder it is that France, with these favourable conditions at hand, for a while at least, entered into the most glorious period of that part of her history which relates to the development of chemistry and the arts dependent thereon. It is difficult to imagine that Germany, which now occupies such an enviable position in chemistry, was so far behind that even, in 1822, when Liebig wanted to study chemistry at the best schools, he had to leave his own country, and turn to Gay-Lussac, Thénard, and Dulong in Paris.

Britain was not slow to avail herself of the new opportunities latent in chemical manufacture and so clearly indicated by the first successes of the French. The linen bleacheries in Scotland and England soon used an improved method for bleaching with chloride of lime, developed by Tennant, which carried in its train the manufacture of other chemicals related thereto, such as sulphuric acid and soda. From this epoch, therefore, dates the beginning of the development of that important industry of heavy chemicals in which the British led the world for almost a century. In like manner England had become paramount in another important branch of chemical industry—the manufacture of coal gas.

The Germans, however, were soon to make up for lost time, for very speedily the former pupils of France became the teachers of the world, carrying the study of chemistry from pedagogic boresomeness into a captivating cross-examination of nature. Research in organic chemistry became more and more fascinating, and coal-tar, a troublesome by-product of gas manufacture, became the source of a bewildering number of new compounds, whose constitution received explanation on the brilliant theory of Kekulé. This development of organic chemistry began to experience rapid rewards—entirely new and successful industries, based on scientific data, springing up in England and France, as well as in Germany.

During these pioneering years of chemical theory and practice, one finds Messrs. Griffin exceptionally active. So far back as 1826 appeared "Chemical Recreations," by J. J. Griffin, followed, in 1832, by a "Manual of Analytical Chemistry," by H. Rose, a book which must have been a boon to chemical students of that day when Liebig had just inaugurated his laboratory system, and, in conjunction with Wöhler, had succeeded in accomplishing the direct synthesis of urea, a revolutionary discovery of such import as to upset all previous ideas on the distinction between organic and inorganic compounds, the so-called "vital force" of previous theorists now disappearing for ever. The parallel progress of literature with scientific discovery is seen in the publication of "Electro-Chemistry," by Sir Humphrey Davy, and "The Practice of Photography," by R. Hunt in 1841. Compositors were catered for in 1848 by Graham's text-book on the subject, while, in 1850-51, the sugar industry received attention in Kerr's volume on "The Cultivation of the Sugar Cane and the Manufacture of Sugar," and Shier's treatise on "Directions for Testing Cane Juice." In 1853, J. J. Griffin's "Practical Treatise on the Use of the Blow-Pipe," introduced to the student a guide to the application of this new and exceedingly useful tool in analytical investigation. This was followed, in 1854, by Thomson's "Cyclopædia of Chemistry," which provided an important summary of chemical knowledge up-to-date. In 1857 an exposition of "The Radical Theory in Chemistry," gave to English readers an opportunity of obtaining a systematic compilation of the ideas which had been dominating chemical science. For some considerable time the stream of chemical progress had been divided into two branches—following the radical and type theories. These branches, originally separated by a thick growth of misunderstandings, were eventually reunited about this period. From 1854 onwards many books on Pure and Applied Chemistry were published, among which Hunt's "Manual of Photography," and Faraday's "Lectures on the Chemical History of a Candle" must be cited. The "Book of Trades," by R. Griffin, and the "Merchant and Iron Trades' Guide and Companion," by J. Hogg, both in 1860, afford an early example of the enterprise which the firm has always exhibited towards the co-operation of science and industry.

After this brief review of the origins of modern applied chemistry, a rapid sketch will now be given of the more vital industries and of the technical literature relating thereto. This will illustrate how closely Messrs. Griffin have associated themselves with chemical progress and so enabled the scientific public to keep abreast of the latest developments in applied science, either by means of works written by the leading British authorities or by translations of the best Continental experts. It is interesting to find that the firm was the earliest publisher of the *Chemical News*, a journal founded and edited by the late Sir William Crookes, which has remained the only weekly paper devoted mainly to chemical science. A glance at these pioneering numbers reveals a most entertaining programme, including an address, "On the Importance of the Study of Chemistry," by Hofmann, then Professor at the Royal College of Chemistry, in compliance with an invitation from the Committee of the Council on Education.

THE CERAMIC INDUSTRY.—The ceramic industry, which has grown to such colossal dimensions during the past century can be well studied from Messrs. Griffin's publications. Porcelain itself owes its origin to the alchemistic studies of Böttcher during the reign of Frederick III. of Prussia (1688-1713), and constitutes one of the romances of science. Having succeeded in making gold before witnesses, Böttcher was seized by order of the Elector of Saxony and interned at Dresden, where, although unsuccessful as a gold producer, he founded, along with the physicist Tschirnhaus, the celebrated porcelain industry. The Great Frederick, like his ignoble successors, placed much faith in secret agents, and it was by the machinations of spies that he succeeded in discovering the secrets of the Dresden porcelain manufacture and in establishing the celebrated Berlin Royal Porcelain Factory, whose products include the well-known crucibles and evaporating basins. The flourishing state of German porcelain and pottery manufacture will be realised from the fact that, during the past twenty-five years, the number of works has increased from 228 to 359, and the number of employed from 37,000 to 66,000, while the export of china, earthen- and stonewares were valued in 1912 at upwards of 3½ millions sterling. Clay and kaolin constitute the prime raw materials for this industry, and it is significant that Germany imported 248,736 tons of kaolin in 1909, of which the best qualities came from England, and exported only 27,000 tons.

THE ENAMEL INDUSTRY.—An industry of ever-growing importance and closely akin to that of porcelain is that of "Enamelling." Generally speaking, the enamels themselves are vitreous compositions capable of adhering by fusion to the surface of metal or pottery. The base of the enamel is usually a colourless glass, in which are suspended particles of an opaque metallic oxide or salt, generally stannic oxide. Up to about 900° C. tin dioxide exists as a fine suspension in the enamel, but at a higher temperature combination or solution may occur and opacity be diminished. Colour is imparted to the enamels by the introduction of various compounds, generally metallic oxides, the use of which in many cases has been known from remote ages—*e.g.*, the ancient Egyptian blue enamel or glaze contains a definite copper calcium silicate forming crystals remarkable for their intense pleochroism.

The enamelling of pottery is a simple operation, since it consists in the mere fusion of an opaque glaze on to the surface of the ware. But the application of a vitreous body to a metallic surface is much more difficult, and it is to this process that the term "enamelling" is sometimes restricted, while the works of art produced by enamelling on metal are themselves known as enamels. The chief initial obstacle to success was the obtaining of ground enamels, whose expansion coefficients were identical with that of the sheet iron used, and it was by solving this problem that the scientist displaced the empirical investigator and so laid the foundations of this most useful industry. Recent years have witnessed a great revival in artistic enamelling.

Mention must here be made of the development of fuel technology, since this has been a most vital factor in the history of scientific enamelling; the basis of the former was the pioneering work of Ferdinand Fischer, Bunte, Orsat, Siemens, etc., who investigated processes of combustion, combustion products, and ventilation problems, in addition to gas analysis.

In 1895 Messrs. Griffin touched the ceramic industry by their publication of a most important work by Redgrave and Spackman on "Calcareous Cements," a field extended, in 1908, by Gatehouse in "A Handbook for Cement Works' Chemists." In 1906 appeared Searle's "Clayworkers' Handbook," a manual for all engaged in the manufacture of articles from clay, and supplemented, in 1912, by "An Introduction to British Clays, Shales, and Sands."

The last volume is full of interesting material, and gives evidence of a very large amount of valuable technical knowledge. A treatise, in 1917, on "Refractory Materials" completes this series for the present. "Ceramic Literature," published in 1910, is a work of inestimable value for all serious students of ceramics, having been compiled by Solon, the President of the English Ceramic Society; it contains an analytical index to the works published in all languages on the history and technology of the ceramic art; also to the catalogues of public museums, private collections, and auction sales in which the description of ceramic objects occupy an important place; and to the most important price lists of the ancient and modern manufactories of pottery and porcelain. In 1914, Vol. I. was published of the collected papers from the County Pottery Laboratory, Staffordshire, edited by Mellor under the title of "Clay and Pottery Industries."

Enamelling literature is unfortunately poor in such treatises as would make an hitherto purely empirical province accessible to science. This fact is explained by the youth of the modern enamelling industry as well as by the reticence practised until quite recently. Messrs. Griffin, however, have made the subject as available as possible to English readers by publishing translations of three volumes written by Julius Grünwald, one of the greatest Continental experts, and formerly works' manager for the famous firm of Jaffé Frères. These are—"The Theory and Practice of Enamelling on Iron and Steel," which appeared in 1909, and was then described by the *Iron and Steel Trades' Journal* as combining theory and practice in a most effective manner; "The Technology of Iron Enamelling and Tinning" in 1912, and "The Raw Materials of the Enamel Industry and their Chemical Technology," in 1914, a book containing very full details on the requisite substances for enamel preparations and the more important pigments, together with a collection of general enamel recipes. Should enamelling obtain a place among the essential industries to be established in this country, not a little will be due to Messrs. Griffin for their enterprise in providing the scientific public with the standard works on the subject.

THE CYANIDE INDUSTRY.—During the early part of the eighteenth century Diesbach, a Berlin colour-maker, stumbled across a result which has proved of enormous industrial importance. He was preparing Florentine lake, a red pigment produced by adding caustic potash to a solution of cochineal extract and an iron salt. It so happened, however, that the potash used by Diesbach had been in contact with bone-oil containing some cyanide, and the result was a magnificent blue colouring matter in place of the pigment anticipated. This substance, which is still known as Berlin or Prussian blue, was the first cyanogen compound to be discovered. Every source of cyanogen has since been exploited for obtaining these compounds which are exceedingly valuable in organic chemistry, while, in recent years, the employment of sodium and potassium cyanides for gold extraction has added enormously to their demand. As a consequence many synthetic methods have been devised for their production. Full details of this branch of chemical technology are contained in "Cyaniding Gold and Silver Ores," by Julian and Smart, and in "The Cyanide Process of Gold Extraction," by Park.

THE SULPHURIC ACID INDUSTRY.—Sulphuric acid is the fundamental chemical par excellence, its use in almost every industry having even evoked the assertion that the consumption of sulphuric acid by any nation is a measure of the degree of the civilisation of that country. While this statement is necessarily exaggerated, nevertheless the acid is in such general use that there is a considerable element of truth in the assertion. Although the exact amount of sulphuric acid manufactured is difficult to estimate accurately, one reason being that much of the acid made never comes on the market at all, being produced for internal use, yet it is safe to estimate the world's annual production, calculated on the basis of 100 per cent. H_2SO_4, as 7-8 million tons.

THE SODA INDUSTRY.—The production of sulphuric acid on any considerable scale had its origin in Birmingham, where Roebuck, in 1746, introduced the classical lead-chamber process. At the beginning of the nineteenth century it became an industry of great importance, particularly in England, because of the acid being required by the Le Blanc process for the manufacture of carbonate of soda. The latter industry was taken up in 1814, more especially for soap-making purposes, and it was in England that the manufacture of soda assumed the largest proportions, a contributing factor being the great development of our cotton industry. During a large part of the past century England made Le Blanc soda, sulphuric acid, and bleaching powder for most of the world, but, during the latter half of the century, the appearance of the rival ammonia soda process brought competitive prices for soda down from £16 to £4 a ton.

THE CHLORINE INDUSTRY.—The displacement of Le Blanc by ammonia soda involved the introduction of new methods for the manufacture of chlorine, and resulted in the successful production of electrolytic chlorine, by which, eventually, half the world's output of bleaching powder was made.

BROMINE.—After electrolytic chlorine came liquid chlorine, of which large quantities are used at Stassfurt for the annual preparation of 500,000 kilos. of bromine, while, for the production of chloracetic acid to be used in the manufacture of synthetic indigo, over 1 million kilos. of chlorine were used by the Badische Aniline and Soda Fabrik in 1900.

OLEUM.—Since the beginning of the present century the so-called contact process has competed with the old chamber process, especially in the manufacture of strong sulphuric acid and oleum, and the great development of the former method has been largely instrumental in making Germany and the United States independent of English production. The coal-tar industry, which is the largest consumer of inorganic products, was the direct cause of the invention of the catalytic process of manufacturing sulphuric anhydride, since it was found that for the preparation of alizarine the sulphenation of anthraquinone was a more economic method than the older dichloranthracene process. The use of ordinary concentrated oil of vitriol, however, proved to be very destructive at the elevated temperatures which had to be employed for sulphonation, whereas the fuming acid—*i.e.*, oleum—was much more efficient at lower temperatures, although its production constituted a difficulty. Experiments had convinced Messel some time previously that, given pure gases, the catalytic action of platinum was the rational solution of the problem of making oleum, but he had to wait until 1875 before the demand came to him from an alizarine factory. From this year dates the inauguration of an industry which has proved itself to be indispensable for colour products, as also for the refining of certain petroleum oils, mainly the Russian oils and vaseline, and the explosives industry.

Blount and Bloxam's "Chemistry for Engineers and Manufacturers" contains much detail on the subjects of sulphuric acid and alkalies, but important information is to be obtained throughout many of Messrs. Griffin's technical publications bearing on industries in which these chemicals are fundamentally employed—*e.g.*, "The Bleaching and Finishing of Cotton," by Trotman and Thorp.

Before leaving the subject of acids, reference might be made to a useful addition to the literature bearing on that most important of organic acids—acetic acid—in Mitchell's volume on "Vinegar," which appeared in 1916.

THE HYDROGEN INDUSTRY.—The electrolytic production of soda and chlorine is accompanied by enormous volumes of hydrogen gas, which were allowed to go to waste at the outset, but have found such application within recent years that hydrogen now constitutes one of the most important chemicals. Mention of a few uses will show the extent to which hydrogen has now entered into our economic existence:—(1) For balloons and lighter than air craft; (2) for autogenous welding with the oxyhydrogen flame, although the oxyacetylene flame is now more commonly used; (3) for production of artificial gems by oxyhydrogen flame; (4) for the hardening of fats, a process depending on the transformation of unsaturated into saturated organic acids by means of hydrogen in presence of a catalyst, such as nickel or palladium. Of late years the demand for hard fats has been considerably greater than the natural supply, owing to the manufacture of margarine and other foodstuffs. In consequence, the satisfactory methods which have been inaugurated for the conversion of cheap oils or liquid fats, such as whale oil, fish oils, etc., into solid fats, are of great industrial importance. A great advantage of the hydrogenation process is that materials which could only be used formerly for the preparation of soft soaps can now be converted into materials from which hard soaps are produced; moreover, hardened oils seem likely to have an extensive use in the near future for lubrication purposes and in the tanning industry. On this subject of "Oils, Fats, Butters, and Waxes," Messrs. Griffin have published a comprehensive treatise by C. R. Alder Wright, revised and re-written in part by C. Ainsworth Mitchell; this volume also deals with the

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manufacture of cognate materials, such as candles, soaps, etc. (new edition at press).

THE GAS MANTLE INDUSTRY.—A special feature of the past twenty-five years has been the progress made in artificial illumination, especially by means of gas. As a consequence the coal gas industry has received a fresh lease of life, and is now well able to hold its own against its electrical rival. The root cause of all this progress has been the introduction of the so-called "gas mantle" by the Austrian Count Welsbach, and the source of the raw materials, known as the rare earths, for the mantle manufacture is monazite sand, of which the bulk occurs in Brazil. The working up of this sand by a fractional crystallisation process had already been brought to a high pitch of perfection many years before in the laboratory of Sir William Crookes. The actual manufacture of incandescent gas mantles, however, cannot be said to have been a commercial success until 1893, when Welsbach patented the use of a mixture containing 98-99 per cent. of thorium oxide and 1-2 per cent. of cerium oxide. In these proportions the oxides have their maximum light-giving power, and no other oxides have so far been found of equal efficiency. Some idea of the enormous and increasing scale in which the incandescent lighting manufacture is carried on in the various countries may be gathered from V. B. Lewes' statistics that the consumption of gas mantles in 1912 was—England, 38,000,000; America, 60,000,000; and Germany, 100,000,000. The special tax imposed by Germany on lighting apparatus realised £800,000 in 1912, and was one of those extraordinary financial expedients resorted to by Germany during recent years to provide the wherewithal for the stupendous national effort to subjugate Europe, of which we have been the unfortunate witnesses during the past five years.

The Metal Filament Industry.—Another outlet for the use of hydrogen has been in reducing the rare metals osmium, tantalum, and tungsten from their oxides. In 1903 the Auer Company showed that an economy of 50-60 per cent. of current could be effected by replacing the carbon filament of incandescent electric lamps with osmium. Later, in 1905, Siemens and Halske demonstrated that a tantalum filament was cheaper and more advantageous, while, in 1906, the tungsten filament was shown to be even better. Tungsten occurs in sufficient quantity in nature as wolframite (iron tungstate) and scheelite (calcium tungstate) to enable the metal to be sold, before 1914, at 6s. to 7s. per kilo.

The Fixation of Nitrogen.—Another important advance in chemical technology is that of fixing the nitrogen of the air. Crookes was the first to point out the necessity of a solution to this problem in his address before the British Association in 1898, in order that foodstuffs may be produced for the teeming millions of the future after the exhaustion of the deposits of Chili saltpetre. Crookes undoubtedly seemed at that time to be an alarmist, lest our food supply could not keep pace with our requirements, but, like a true physician, he prescribed the remedy, pointing out that while electricity produced by coal and steam engines would be too costly, yet Niagara was capable of affording all the energy required for supplying the world with nitrogenous fertilisers without material reduction of its mighty flow. During recent years the fixation of atmospheric nitrogen has been successfully accomplished by several methods, the first of which, installed in Norway where abundance of water-power renders cheap electrical energy available, involved the use of an electric furnace (Birkeland-Eyde, Pauling, or Schönherr), and was the realisation on the industrial scale of laboratory experiments made by Cavendish 130 years previously. A second method is based on the property possessed by calcium carbide of fixing nitrogen at high temperatures, the product being crude cyanide, which may be used directly as a nitrogenous manure or made to yield ammonia. The most interesting feature of this method is the use of pure nitrogen prepared preferably by the fractional distillation of liquid air. Messel says that "we are becoming familiar in industry with the impossible," but who could have expected such a possibility only a few short years ago? Think of the excitement caused in the scientific world when, in 1877, Pictet and Cailletet first succeeded in liquefying oxygen. Pictet's work was then described as the most brilliant achievement in modern science. The barrier between condensible and permanent gases was broken down, and the latter term deprived of its significance; but how much work remained to be done, what ingenuity had yet to be exercised to translate this scientific discovery into a process for the industrial preparation of nitrogen. Success, however, has been achieved through the exertions of several of our greatest authorities, and nowadays every gas that is required is readily procurable in the liquefied form (*e.g.*, chlorine, sulphur dioxide, nitrous oxide, carbon dioxide, ammonia, etc.) in the well-known steel cylinders capable of withstanding enormous pressures.

Calcium Carbide.—Calcium carbide—one of the most fascinating compounds introduced into industry—had lain dormant since its discovery, in 1862, by Wöhler, until Wilson and Moissan made use of the electric furnace for its production. Now its manufacture constitutes a mighty industry, close on 300,000 tons being produced annually. In addition to its use as the raw material for calcium cyanamide, which latter is also coming to the fore as a source for cyanides, calcium carbide is now the parent of numerous other products of great importance, notably acetylene, so largely used as an illuminant and for welding and cutting metals. In "Acetylene," by Leeds and Butterfield, Messrs. Griffin have published a most reliable work of reference on this subject, while "The Practical Manual of Autogenous Welding (oxyacetylene)," by Granjon and Rosemberg, gives the methods of industrial application.

A third process for the fixation of nitrogen involves the combination of nitrogen and hydrogen at high temperatures, and especially under high pressures. The long-known fact that the reaction, $N_2 + 3H_2 = 3NH_3$, is realisable to a very small extent has been investigated by Haber and Le Rossignol at Karlsruhe, and, after extraordinary technical difficulties had been surmounted, a process was evolved which promises to be the most likely for capturing the inorganic nitrogen market of the world. Interesting details on the saltpetre question are contained in Grünwald's "Raw Materials of the Enamel Industry."

The Potash Industry.—While on the subject of fertilisers mention must be made of the potash industry. Germany appears to be alone in possessing vast deposits of potash salts, the enormous value of these to agriculture being first demonstrated by Liebig, and made public by him in 1840 in his famous volume, "Application of Chemistry to Agriculture and Physiology." This work may, without question, be regarded as the foundation-stone on which agricultural chemistry has been raised. The celebrated deposits of potash salts were accidentally discovered in 1857 when boring for rock-salt at Stassfurt, near Magdeburg, in Prussia. Their industrial exploitation on an ever-increasing scale was begun in 1861 by Grüneberg and Frank, when the output of crude potash salts was 2,000 tons, while, by 1912, this had increased to 11,000,000 tons. The war, by cutting off German supplies, has led to a vigorous search for sources of salts of potassium, and in this connection the extraction from sugar residues and wool scouring is likely to prove of value as a side issue to these industries. Attempts have also been made to extract potash salts from seaweed. The production of potash products from felspars, however, has proved a difficult problem, and does not appear to contain remunerative prospects in normal times unless combined with the production of other materials of definite market value and in considerable demand.

Explosives.—In the nineteenth century the active application of science to explosives commenced, with the result that this industry, like so many others, developed enormously. Gun-cotton was discovered by Schönbein at Basle in 1845-46 during some experiments upon highly oxidised bodies, following up a train of thought suggested by his discovery of ozone in 1844. Pélouze had made an explosive in 1838 by the action of nitric acid on cotton, but he did not take the important step of mixing sulphuric acid with the nitric acid, nor did he make any practical application of his explosive. Böttger, of Frankfurt, discovered gun-cotton independently in 1846, but entered into an arrangement with Schönbein to share the profits of the invention. Nitroglycerine was discovered by Sobrero in 1847, but no practical application was made of it for a considerable time, until Nobel found that it could be exploded by a detonator containing fulminate, and he commenced its manufacture in 1862. The disruptive powers of gun-cotton are greatly moderated by gelatinising with solvents (such as acetone, acetic ester, alcohol, ether, etc.), while, by admixture with nitroglycerine, ballistic materials are obtained, such as cordite and other smokeless powders. Picric acid was first used by the French for shell-filling in 1881, under the name of melinite, and, later, by England as lyddite, while, in 1891, T.N.T. (trinitrotoluol) first came into service,

The enormous demands for explosives during the war have naturally led to remarkable improvements in methods of manufacture, as well as to new combinations of ever-increasing power. As the magnitude of the Continental struggle gradually became obvious, it was realised that the whole of the resources of the British Empire would have to be fully utilised if success was to be attained. A census of all available products had to be taken, and schemes for their exploitation laid down; all materials had to be apportioned with the knowledge that whatever was used for the manufacture of one particular war product left a corresponding shortage of that particular raw material in connection with the manufacture of some other, and perhaps equally essential, product. At the time of the armistice this country was making about 100,000 tons yearly of nitric acid and sulphur trioxide, 60,000 tons of T.N.T., and 35,000 tons of cordite. Quoting from Prof. Pope:—" A very pertinent question arose in connection with the fact that our production of the chemical materials needed for a great European war, though negligibly small in 1914, gradually attained satisfactory dimensions. The great chemical factories of Central Europe could divert their production of chemical products to a war production at very short notice; why, then, were the Allied nations given time to develop their war production of explosives and noxious materials from nothing?"

Mustard Gas.—The answer was given by an example: " When, in July, 1917, the Germans first began to use the so-called mustard gas, British technical chemists were amazed to find, from examination of the product, that it was being manufactured by a technically cumbrous process that gave an over-all yield of perhaps 40-60 per cent. of the theoretical. By the end of January, 1918, we had worked out a process which yielded, in the laboratory, 98-99 per cent. of the theoretical. This was communicated to our Allies, who, at the time of the armistice, had an available daily production of mustard gas equal to the monthly production of the Central nations."

Explosives are of enormous importance also in civil life—in mining and engineering—and have rendered possible such gigantic achievements as the Panama Canal. They are also being employed with great advantage in afforestation for loosening the ground in which trees are to be planted.

ARTIFICIAL SILK AND THE CELLULOSE INDUSTRIES.—An eminently peaceful industry which is closely related to that of explosives is the production of artificial silk and celluloid. This is a branch of the catholic cellulose industry, which latter includes wood and timber preservation; the production of wood pulp for paper; the great paper industry itself, which utilises linen rags, esparto grass, wood pulp, mechanically-powdered wood, etc.; mercerisation, by which the cotton fibre, when brought into contact with sodium hydrate solution containing more than 10 per cent. Na_2O, changes from a hollow flattened riband to a thickened cylinder with practically no hollow, and becomes not only stronger, but acquires an increased dyeing capacity; collodion; celluloid substitutes; nitro-cellulose lacquers, varnishes, dopes, etc. The chief kinds of artificial silk are:—(1) Nitrated cellulose, which, when denitrated, becomes Chardonnet silk; (2) Glanzstoff, Sirius, and Meteor silk produced by the cuprammonium process; (3) Viscose silk, discovered by Cross and Bevan when treating dissolved cellulose with a concentrated solution of caustic soda and then with carbon bisulphide; (4) Acetate silk, which differs from the preceding varieties in that cellulose acetate is used instead of cellulose, the result being considerably stronger and harder than the cellulose silks, while also non-inflammable. Artificial silk is used in rapidly increasing quantities for glittering braids and trimmings and for relief on cotton cloths. Indeed, for these purposes it is far better than real silk, since it gives excessive brightness to the fabric. Artificial silk is also used in the form of insertions for ladies' blouses, ties, scarfs, and wearing apparel generally, while the manufacture of furniture stuffs and carpets is now beginning, since such cloth is much more readily freed from dust than real silk cloth. The world-production is estimated at about 7,000,000 kilos.

The cellulose industries furnish a particularly striking example of the manner in which chemical research and invention are able to enhance the value of the kindly gifts of the earth, thus:—1 cubic metre of wood has a fuel value of about 6s.; after boiling with lime, soda, and sulphite, it becomes paper pulp and appreciates to £1 12s.; after becoming paper the price attains £2 16s.; while, when converted into artificial silk, a value ranging from £80 to £240 is reached.

Celluloid is a mixture of a low-nitrated cellulose, usually termed pyroxylin, and camphor, and was discovered by Alexander Parkes about 1860, and again, later, by the brothers Hyatt, of Newark, U.S.A., in 1869. These substances, when pressed together and warmed, unite to form a transparent substance, which is not explosive, and which possesses properties very different from the component bodies. The nature of the union is unknown, but it is believed to be a solid solution and not a definite compound. Celluloid is of manifold use and of ever-growing importance, as will be seen from the following selection:—Films, combs, handles of sticks and umbrellas, hollow articles such as balls, linen, printers' blocks, stamps, teeth, phonographic cylinders, beads, buttons, lacquers, photographic materials, etc. Since camphor is expensive a large number of substitutes have been proposed, those in common use being:—Acetanilide, mannol, metacelludol and gelatine. The effect of substituting translucent products, such as naphthalene and colophony, has been tried, but with unsatisfactory results, the material obtained being generally deficient in plasticity and possessing a disagreeable odour.

VISCOSE, BAKELITE, ETC.—By the side of the products derived from nitrocellulose and camphor, or from nitrocellulose alone, are a large number of bodies whose compositions are quite different from that of celluloid, but which may, on account of their physical properties, replace it in the majority of its uses. Typical substances are viscose and viscoid, the casein derivatives, bakelite, and the cellulose acetates, which latter appear to have a bright future. The manufacture of cellulose esters and plastics has been stimulated by war conditions, but the processes undergoing development are mainly of pre-war origin. The trend of German research in the domain of cellulose explosives and plastics during the early stages of the war before the scarcity of cotton became acute is interesting, inasmuch as wood cellulose was found to be capable of nitration both for gun-cotton and celluloid, and to give products satisfying all the specifications established for nitrated cotton, provided it was previously transformed into thin tissue paper of suitably open texture. The form of wood cellulose employed by Schwalbe was soda wood pulp, which is free from the objectionable resinous impurities present in sulphite wood pulp. There is reason to believe, however, that later practice in Germany has adopted the more normal sulphite pulp after submitting it to a special de-resinifying treatment involving extraction with dilute alkali.

With respect to the literature on the subject, Messrs. Griffin were to the fore in 1912 by their publication of a translation of the first comprehensive work on "Celluloid," by Masselon, Roberts, and Cillard, which included its manufacture, application, and substitutes. This book contains an exhaustive study of the nitration process which is of estimable value for most of the industries referred to in this brief review of the development of the explosives industry. In order to confer on the work an essentially practical character, the descriptions have been supplemented by numerical data relating to the formulæ of mixtures and of colouring matters, the duration of the operations, the consumption of raw materials, steam, water, cost of labour and power, together with calculations having direct application to the installation of workshops and the costs estimated for a given daily output. In 1906 appeared an exceedingly instructive manual on "Paper Technology," by Sindall, which deals with the manufacture, physical qualities, and chemical constituents of paper and of the paper-making fibres. Bromley's "Outlines of Stationery Testing," giving in simple language concise instructions for the practical examination of paper by physical, microscopic, and chemical methods, was published in 1913. "The Manufacture of Ink," by Mitchell, issued in 1904, is a handbook concerning the production and properties of printing, writing, and copying inks which might be noticed at this juncture.

FERMENTATION INDUSTRIES.—Many of the world's oldest industries, such as the making of wine, beer, and vinegar; the souring and clotting of milk to form cheese; the tanning of hides, etc., are dependent upon the action of ferments to which bacteria and other organisms or living tissues give rise. The same is also true of the fermentation processes employed in the extraction of natural indigo, in the preparation of coffee and cocoa, in the curing of tea and tobacco, and in the retting of flax. These ancient industries have come more and more under scientific control until, at the present time, the fermentation industries have become an important branch of chemical technology. In this subject Messrs. Griffin have published several volumes, including translations of some notable German treatises. "The Principles and Practice of Brewing," by Sykes, was issued in 1897, and was followed, in 1898, by Vol. I. of "Technical Mycology," by Franz Lafar, the first work of its kind to lay claim to completeness on the subject; Vol. II. of Lafar's book did not appear until 1910; "Micro-organisms and Fermentation," by Jörgensen, and "Ferments and their Actions," by Oppenheimer, are also noteworthy treatises on this all-important theme. Other books dealing with the same and similar industries are, "Foods: their Composition and Analysis," by A. W. and M. W. Blyth; "Laboratory Methods in Agricultural Bacteriology," by Lohnis; "Elementary Agricultural Chemistry," by Ingle; "Dairy Chemistry," by Richmond, a book which the *Lancet* describes as the best contribution on the subject that has yet appeared in the English language (1899); "The Laboratory Book of Dairy Analysis," by Richmond; "Milk: its Production and Uses," by Willoughby, which the *Dairy World* cordially recommends to everyone who has anything at all to do with milk; and "Food Supply," by Bruce, described by the *Journal of the Royal Colonial Institute* as a work which will appeal to those intending to become farmers at home or in the Colonies, and who desire to obtain a general idea of the true principles of farming in all its branches.

SYNTHETIC ORGANIC CHEMISTRY.—Out of the profound study of synthetic organic chemistry made during the past sixty years have emerged the great industries of the artificial dyes, drugs, and perfumes. The earlier and pioneering achievements in this branch of chemistry are well distributed amongst the nations of Europe, England and France being especially to the fore, but, during the major part of the sixty years, the great bulk of the discoveries in this domain have been made in Germany. Prof. Frankland (to whom the writer is indebted for much of the information in this chapter) has stated that it is in the possession of schools of research, both in the Universities and in the chemical factories, that Germany has, by two generations, the lead of all other countries in the world. This deficiency is now happily being remedied in our own country, and Dr. Fisher (President of the Board of Education) opines that thirty years hence his successor at the Board will have no reason to complain of the neglect of science.

THE DYESTUFF INDUSTRY.—An analysis of the prewar situation shows that the British dyestuff industry was almost completely dominated by Germany, both as regards production and supply. In 1913 the total consumption of artificial dyestuffs in the world had attained a value of over £18,000,000, of which amount Germany furnished 74 per cent., in addition to over one-half of the materials needed to produce the remainder. The value of the dyestuffs annually consumed in England is, approximately, £2,000,000, and the value of the trade in which these dyestuffs are employed is £200,000,000, whilst upwards of 1,500,000 workers are dependent upon these industries. The total value of the dyestuffs imported into the United Kingdom in 1913 was £1,892,055, of which Germany contributed £1,730,821.

So much for the statistics, and now a line or two on the chemical history of the subject.

In 1856 Perkin obtained a colouring matter from crude aniline by oxidation, and put it on the market under the name of "Mauve." Until that date the whole of the available colouring matters were of natural origin, chiefly vegetable. Previous to the discovery of mauve, picric acid and rosolic acid had been produced artificially without finding commercial application for colouring purposes, although both have since been used as such. Research during this period was in an empirical stage, and aniline was treated indiscriminately with all kinds of reagents. In 1859 Verguin obtained "Magenta" (also known as Fuchsine and Rosaniline), and, in 1862, Girard and de Laire obtained a spirit soluble blue by heating magenta with aniline. In 1862 Nicholson sulphonated aniline blue and made it water-soluble, thus obtaining the first true acid dye; and the soluble blues, of which Nicholson's blue was the parent, are still in extensive use. About this time the researches of Hofmann, Rosenstiehl, and E. and O. Fischer went far towards explaining reactions in the triphenylmethane series which includes magenta and its derivatives. The azo-colours really date from the discovery by Griess, in 1864, that diazo compounds unite with amines, and, later, by Kekulé and Hidegh, that they combine with phenols. The first commercial azo-dye, Bismarck Brown, discovered by Martius in 1865, has been prepared commercially since 1866, from which date the azo-colours have attained an enormous influence and have practically banished cochineal and logwood from the dyeworks. Congo colours—the first substantive cotton dyes—were discovered by Böttiger in 1884. Alizarin (the essential principle of the madder root) was first synthesised by Graebe and Liebermann in 1869, and its manufacture rapidly destroyed the madder industry. This substance has in turn become the starting-point for a large number of most valuable dyestuffs. Baeyer's discovery of the phthaleins in 1871 led to the production of the eosines in 1874, and introduced the enormous demand for phthalic anhydride and resorcinol.

Indigo, the most highly-prized blue dyestuff of both the ancient and modern worlds, was first synthesised by Baeyer in 1880, but it required seventeen further years of unremitting and laborious investigation in the works of the Badische Aniline and Soda Fabrik, and the investment of nearly £1,000,000, before the laboratory synthesis was translated into a commercially successful industry. By 1907 no less than 316 patents had been obtained by Germany for processes connected with the preparation of indigo. The effect of the synthetic product upon the indigo plantations will be realised from the fact that 1,500,000 acres were under cultivation in British India in 1896, while, by 1913, the number had decreased to 300,000 acres. The price meanwhile had dropped from 16s. per kilo., in 1897, to 7s. per kilo. in 1913. By varying the ingredients in the indigo synthesis many valuable dyes related to indigo have been obtained. It is interesting to note that the famous Antique or Tyrian Purple of the ancients proved to be 6·6 dibrom-indigo.

The discovery of these valuable dyestuffs provoked zealous emulation on the part of the azo-colour chemists, and the response was some excellent new products which appeared on the market under the name of benzo light colours.

The discovery of "Primuline" by Green in 1887, and the new class of colours derived therefrom, is a notable achievement to the credit of English chemists, and followed the introduction by Messrs. Read, Holliday & Sons, in 1880, of the original principle of developing azo-dyestuffs on the fibre.

In 1893 Vidal patented the first important sulphide dye in "Vidal Black," and this was followed by a period of great activity in the discovery of new dyes of this class which has lasted up to the present, but now shows distinct signs of falling off, at any rate until a more intimate knowledge of the structure of these compounds is rendered available.

The last stage of dyestuff development began with the preparation of "Indanthrene Blue," by Bohn, in 1901, whereby a new series of vat dyestuffs was inaugurated, which has since been enriched by many new syntheses of indigo derivatives. The manufacture of intermediate products for dyes, and the consequent demand for pure coal-tar products, has run parallel with dyestuff discovery.

ARTIFICIAL DRUGS AND PERFUMES.—The production of artificial drugs and perfumes is in reality only a branch of the artificial colour industry, the raw materials being generally the same, and the methods of investigation and synthesis identical. The industry may be said to date from Liebig's discovery of chloroform in 1831, and of chloral hydrate in 1832. The discovery of antipyretic drugs, the rivals of natural quinine, was due to a mistake made, in 1867, of acetanilide being sold for naphthalene; the antifebrile effect being noted, it was fortunate that Kahn and Hepp, the purchasers, had enough left for analysis. Antipyrin was discovered about the same time by Knorr. These events led to the systematic study, by direct experiment on animals and human beings, of innumerable chemical compounds with a view of ascertaining their physiological properties, and some idea of the amount of this work may be gathered from the fact that up to 1912 about 5,000 artificial products had been found to possess therapeutical value of one kind or another. Among these synthetic drugs might be mentioned the hypnotics, sulphonal and veronal; the antineuralgics, salicylic acid and asperin; the anti-gout drugs (uric acid solvents), piperazine, lysidine, and urotropine. The synthetic drug suprarenine is of special interest, being the active principle of the suprarenal glands, which is naturally known as adrenaline, and is of great value for increasing the blood pressure, contracting the blood vessels, and arresting hæmorrhage. It required the suprarenal glands of 40,000 oxen to prepare 1 kilo. of adrenaline, but the substance was synthesised by Stolz, starting from catechol.

With regard to the synthetic perfume industry it is particularly noteworthy that one of the pioneering steps in the realisation of artificial perfumes was the synthesis of coumarin by Perkin in 1868.

With respect to the literature of synthetic dyestuffs and the dyeing industry, Messrs. Griffin have rendered service of inestimable value. "The Dictionary of Dyes, Mordants, and Other Compounds used in Dyeing and

Calico Printing," by Rawson, Gardner, and Laycock; "The Synthetic Dyestuffs," by Cain and Thorpe; "The Analysis of Dyestuffs," by Green; and "A Manual of Dyeing," by Knecht, Rawson, and Loewenthal, constitute a set of authoritative volumes which every student of the subject must consult, and which are of fundamental importance in the present revival of the aniline dye industry in England and America. Other valuable works, which deal with the earliest phase of the coal-tar industry—namely, the production of coal gas and fuel generally—are: "The Chemistry of Gas Manufacture," by Butterfield; "The Calorific Power of Gas," and "The Examination and Thermal Value of Fuel," by Coste and Andrews.

THE RUBBER INDUSTRY.—The last industry to be considered in this chapter is one which has come to the fore with a bound during the past two decades—"The Rubber Industry." The marked changes in the physical properties of rubber caused by heating it with sulphur provide an interesting problem for which the solution has yet to be found, yet the growth of the modern rubber industry may be considered to date from 1839, when Goodyear discovered the hot process of hot vulcanisation. In 1846 the cold process of vulcanisation by treatment with sulphur chloride was patented by Parkes, and these two processes, known as hot and cold cure respectively, are in use for the production of the great majority of rubber goods. Recently much attention has been paid to the synthesis of rubber, which latter really dates from 1882, when an elastic polymer of isoprene was obtained by Tilden by treatment with concentrated hydrochloric acid. In 1908 it was simultaneously found by Harris and Matthews that sodium is an excellent agent for the polymerisation of isoprene, the reaction being practically quantitative. Recent work, however, has shown that all synthetic caoutchoucs differ chemically from natural caoutchouc, while, physically, the vulcanised products are equal in quality to those from medium grade natural rubbers. Meanwhile, due credit must be given to the splendid work and results already achieved. This colloid industry is well catered for by Messrs. Griffin, who, in 1902, issued "The Chemistry of India Rubber," by Weber, which is a standard work on the subject; in 1909 "The Manufacture of Rubber Goods," by Heil and Esch; and, still later, "Rubber," by Dubosc and Luttringer, a practical handbook for the use of rubber cultivators, chemists, and economists. Dealing with colloidal chemistry there is "The Chemistry of Colloids," by Pöschl; "Glue, Gelatine, and their Allied Products," by Lambert; and "Leather Trades' Chemistry," by Trotman.

Before concluding this review of Messrs. Griffin's contribution to the literature of chemical technology, mention must be made of the excellent series of standard works dealing with what is generally the main problem in chemical factories—"The Treatment of Effluents."

TREATMENT OF EFFLUENTS.—These are: "A Text-Book on Trade Waste Waters," by Maclean Wilson and Calvert, a book which is as useful to manufacturers as to sanitary authorities; "Trades' Waste," by Naylor; "A Manual of the Principles of Sewage Treatment," by Dunbar and Calvert; and "Modern Methods of Sewage Purification," by G. B. Kershaw. Volumes on cognate subjects must also be noted, such as "Water Analysis," by Stocks, and "Water Supply," by Middleton.

During the past quarter of a century the firm have had as leader Mr. Francis J. Blight, F.R.S.E., to whose pioneering zeal must be ascribed so much of the success which has attended their activities. Mr. Blight, himself an engineer, is an enthusiast in many other branches of science, and this has led to the initiation of publications in almost every branch of pure and applied science. Mr. Blight's aim throughout has been to supply each subject with standard works by authors of the highest repute, and this most valuable contribution to science has been recognised by the great scientific society of Edinburgh, which recently elected him a Fellow.

Finally, no chapter on chemical technology would be complete without reference to that invaluable compilation, "The Year Book of the Scientific and Learned Societies of Great Britain and Ireland," the thirty-sixth volume of which speaks so eloquently of the great service which the firm are rendering to scientific effort. At a glance it affords a bird's-eye view of the higher intellectual work of the country, and may be truly described as indispensable.

PETER MAGUIRE.

Chapter X.

TEXTILE INDUSTRIES AND COGNATE SUBJECTS.

By PETER MAGUIRE, Textile Research Chemist.

One Hundred Years of Progress in the Textile Industries—Griffin's Conspicuous Part—Mechanical Advances—Chemical Knowledge —Aniline Dyes—Spinning—Textile Fibres—Long Vegetable Fibres — Weaving — Bleaching — Chlorine Compounds for Bleaching — Electrolytic Solutions — Mercerising — Dyeing and Calico-Printing—Synthetic Dyestuffs—Analysis of Dyestuffs—Engraving for Calico-Printing—Garment Dyeing and Cleaning—Colouring Matters—Griffin's Books of the Greatest Service.

Chapter X.

TEXTILE INDUSTRIES AND COGNATE SUBJECTS.

PROGRESS generally in the several branches of the textile industries has kept pace during the past hundred years with that chronicled in other spheres of industrial activity during the same period. It is, of course, a period covering many very far-reaching discoveries and their applications to the industrial use of mankind, and the textile industries as a whole have not failed in taking a full share of the benefits that have, from time to time, been so afforded. Towards this progress the publication of practical books of reference has largely contributed, and the House of Charles Griffin & Co., Limited, whose Centenary is celebrated this year, has had a conspicuous place in establishing scientific principles for rule-of-thumb methods.

As a class of industry, that connected with textiles is a vast one, including within its scope such highly specialised branches as spinning, weaving, bleaching, dyeing, calico-printing, and finishing, each of which singly makes great demands upon the resource, energy, knowledge, and enterprise of those engaged on the work, and which, together, constitute to-day, as the textile industry has done for many long years, the most important industry of the nation.

A general view of the century's changes shows that they have been mainly of a mechanical order—the introduction of machinery in place of hand-work. While this applies to all the branches of the textile industry during the first half of the period under consideration, a marked distinction comes into evidence afterwards, when the mechanical side of the question becomes, as the years pass by, more and more important, until it is the main factor of real influence in the progress, or increased production along with improved efficiency, in certain particular branches of the industry, notably in spinning and in weaving. The mechanical side of the subject has likewise exerted a considerable influence on the other branches—bleaching, dyeing, calico-printing, and finishing—but the progress realised in these during the past fifty years or so depends far more upon what may be termed the chemical side rather than the mechanical. In the spinning branch the change was marked by the invention long before (*i.e.*, 1767) of the spinning frame by Arkwright, but it was not until after the first decade of the nineteenth century that machines began to make any very pronounced effect towards general adoption. In the weaving branch, the change was marked by the introduction of Cartwright's power-loom in 1785, and here, again, we have to wait until the nineteenth century has had a good start to see the prophesied changes coming into being. In the bleaching, dyeing, calico-printing, and finishing branches the changes generally may also be clearly distinguished, and if we pass by for the moment the revolutionising of the calico-printing branch that followed the introduction of the printing-roller or cylinder in place of the blocks, it is perceived that the most important are of the chemical rather than the mechanical order.

There was the work first of all of Berthollet, and, later, that of Tennant, in introducing chlorine compounds for the purposes of bleaching in place of the old-time "grassing" methods.

That discovery in itself has since accounted for a most astounding expansion of the whole of the textile industries. The introduction of aniline black marks another very important period of extended activities, but most of all Perkin's classic discovery of the so-called aniline dyes, which benefited both the dyeing and calico-printing branches in increasing their scope of activity. Then came the practical application of the process of mercerising to all classes of cotton fabrics, which has become so widely utilised that mercerising became a branch of the textile industry to itself nearly twenty years ago. These instances serve to denote the changes of primary importance.

SPINNING.

Following upon the invention of the spinning-frame by Arkwright, in 1767, and the mule-frame by Crompton, in 1774-9, came the gradual change towards revolutionising the spinning branch of the textile industries. The change was gradual, indeed slow, as it must needs have been in those days of greatly lacking resources, until well into the nineteenth century, when history records cotton-spinning as a staple industry of Lancashire. The position it occupies to-day is pre-eminent, both in volume and in quality of production, in the industrial world.

In keeping with the traditions of the House of Charles

Griffin & Co. it is not surprising to find that they catered to the desire for technical knowledge by the inclusion in their technological publications of a volume on the subject of cotton-spinning as early as 1855. This volume was named the "Cotton-Spinners' Manual," and was written by an authority of the time, James Montgomery. It occupied the position of a standard work for a considerable period.

Other works bearing upon the subject of spinning are of comparatively recent date. In 1902 the House published "Textile Fibres of Commerce," by Wm. I. Hannan, dealing with the occurrence, distribution, preparation, and industrial uses of the animal, vegetable, and mineral products used in cotton, woollen, and other manufactures.

"The Spinning and Twisting of Long Vegetable Fibres," by Herbert R. Carter (1904) forms an excellent contribution to the subject of the most modern methods applied to the hackling, carding, preparing, spinning, and twisting of flax, hemp, jute, tow, and ramie. A new edition, revised, largely re-written, and greatly enlarged has just been issued.

WEAVING.

Like the spinning branch, weaving also owes its industrial success to the mechanical side of the question. The invention of the power-loom in 1785 by Cartwright marked the change, and at the same time afforded machinists the opportunity for the display of genius in mechanics that has shown itself since then. The automatic Northrop loom came into being in 1894, and that is another achievement marking a further change.

Charles Griffin & Co. contributed to the subject of weaving in 1908 by publishing the "Cotton Weavers' Handbook" as a practical guide to the construction and costing of cotton fabrics, written by Henry B. Heylin. During the war this ran out of print, but a new and revised edition is now nearly ready, re-set on a larger page, and containing every information and latest data.

A further book of great usefulness is the House's "Handbook for Buyers and Sellers in the Cotton Trade," for merchants, shipping manufacturers, and others who are interested as producers or distributors, written also by Henry B. Heylin. It appeared in 1913.

BLEACHING.

The discovery of chlorine by Scheele in 1774 and its utilisation, in association with potash, as a bleaching agent, by Berthollet in 1785, and in association with lime, for the same purpose, by Tennant in 1795, started the movement against the old tedious process of bleaching by boiling in potash, steeping in buttermilk, and exposing the goods for many months to the sun and air in fields.

There appears to be no doubt that Charles Tennant was the first to apply for a patent in the use of bleaching powder, but the patent was declared void because chlorine absorbed by lime had been used some years prior to 1798 in Lancashire. The quicker method began at that time to gain favour, and by 1819 had almost entirely displaced the old slow method. We have it on the authority of Napier (1853) that at that time "the new process of bleaching by means of chlorine is now almost universally practised."

"A Manual of the Art of Dyeing," by James Napier, published by the Glasgow House of Griffin & Co. in 1853 contains a highly interesting dissertation on the subject of bleaching as practised at that period, and of the theoritical considerations then held as explanatory of croft-bleaching.

On the mechanical side a change towards the introduction of kiers, so constructed that the boiling-out of the material in alkaline liquor could be accomplished under pressure, was started in 1837, and by 1840 was adopted fairly largely.

This date marks a definite improvement, and the use since then of the pressure kier in the treatment of cotton goods has been of great service to the industry generally.

This part of the subject is exhaustively discussed in a more recent publication of Messrs. Griffin & Co., "The Principles of Bleaching and Finishing of Cotton," by Mr. S. R. Trotman, M.A., F.I.C., and Mr. E. L. Thorp, A.C.G.I., A.M.I.E.E. (1911).

The inconveniencies and wastefulness of the old-fashioned "household copper" direct method of heating for the treatment of large quantities of cloth brought about indirect heating by means of steam, followed by an automatic method of producing circulation of the liquor, and subsequently followed by boiling under high-pressure in a closed vessel to diminish the time necessary for saponification and to avoid loss of heat. These improvements have been followed by others having for their object the easier manipulation of the goods. Nowadays the liquor is, in some systems, heated entirely outside the kier, and circulates from the external heater through the kier and back again to the heater. In all systems the important mechanism in the kier is that which maintains the temperature and circulation.

These changes, so carefully chronicled in the publication of Griffin & Co. just mentioned, have made it quite a common occurrence to-day in many bleachworks for batches of cotton cloth to be boiled-out and thoroughly scoured in two to four ton lots as a preliminary preparation for the bleaching proper.

As this preliminary preparation of the goods for the bleaching operation is one which controls the quality of the end results more largely than any other operation connected with bleaching, the importance of it is obvious, and accounts for the successful attention that has been devoted to the subject. The improvements so effected during the last fifty years, and the extent of present-day knowledge of the conditions conducive to good results have placed this branch of the art of bleaching on a relatively high plane.

The objective of boiling-out the cotton in alkaline solution is the cleansing of the fibre, and, once that is accomplished, the completion of the bleaching operation is brought about with the aid of chemical agents to destroy the colouring matter natural to the cotton fibre. These chemical agents are oxidising or reducing in reaction, the former being by far the most used, in the form of hypochlorites, mainly bleaching powder.

The application of the hypochlorites for the several purposes of bleaching cotton materials of various sorts and qualities is also brought up to present times in the treatment accorded the subject in Messrs. Griffin & Co.'s "The Principles of Bleaching and Finishing of Cotton Goods."

Indeed, this volume ranks as a standard work on all that pertains to the subject of its title. The subject of bleaching cotton, as well as other textile fibres, is also described and detailed authoritatively in another publication occupying the undoubted position of pre-eminence as a standard work of the House of Griffin: "A Manual of Dyeing," 2 vols., by Knecht, Rawson, and Loewenthal (1910), and many later editions.

And in its bearing on the printing of calico, the subject of bleaching is described by acknowledged experts in Messrs. Griffin's book "The Principles and Practice of Textile Printing," by E. Knecht and J. B. Fothergill (1912), with a thoroughly revised edition at press.

These works afford most reliable sources of information of a very comprehensive character, and have already rendered services that are appreciated in all industrial centres connected with the textile trades, abroad as well as at home, to an extent that reflects great credit to the respective authors and the publishers alike. The progress realised in the art of bleaching is by these channels of information brought to modern times. The interest that has been aroused at various times during the last twenty years or so in other proposed bleaching agents than the time-tried bleaching powder has, of course, received due attention. The use of solutions of hypochlorite of soda prepared electrolytically is one of the proposals that has attracted attention.

By electrolysing a solution of common salt, the electro-negative chlorine ions migrate towards the positive electrode (or anode), while at the electro-negative electrode (or cathode) there is a corresponding accumulation of the electro-positive sodium ions. The sodium which collects at the cathode instantly reacts, however, with the water, forming caustic soda and hydrogen gas, which latter, being practically insoluble in water and very light, escapes as such. The chlorine, on the other hand, collects at the anode. When the electrolysis of the salt solution is effected without a diaphragm, and the electrodes are placed in close proximity to each other, the chlorine does not escape, but reacts at once with the caustic soda found at the cathode producing sodium hypochlorite.

The result is a clear bleaching liquor, a characteristic which alone would recommend this process of preparation for most purposes of bleaching, and a solution of which the condition, alkaline, neutral, or acid, can be easily controlled. Electrolytically prepared hypochlorite of soda certainly affords some advantages over chemically prepared hypochlorite of soda and over ordinary bleaching powder solution, but serviceable as these favourable features may be in a limited number of particular applications, the important factor of relatively high cost of production does not as yet make the proposal sufficiently attractive to the cotton-bleaching industry generally.

It is true, however, that bleaching by means of electrolytically prepared hypochlorite solutions was fairly freely resorted to during the period of the war by reason of the scarcity and consequent dearness of ordinary bleaching powder. The attention so forced by circumstances to the consideration of the subject may lead to its adoption on a scale far beyond any previously reached, more especially if the present cost of £17 per ton of bleaching powder does not return to the pre-war price of £4 10s. The subject of bleaching with electrolytic hypochlorite is, therefore, of special interest to the industry, and is also a subject that receives full attention and informative treatment in Messrs. Griffin's publication "The Principles of Bleaching and Finishing of Cotton Goods," by Trotman and Thorp (1911). This work affords authoritative information on the "Relative Efficiencies of Bleaching Powder and Electrolytic Solutions," and the various "Types of Electrolysers."

Other oxidising bleaching agents that have found some applications in the textile industries are hydrogen peroxide, sodium peroxide, the perborates, and potassium permanganate.

All are very serviceable bleaching agents, but the peroxides and perborates are limited, owing to their cost, in application to the treatment of certain classes of delicately constructed cotton fabrics, such as expensive lace materials. and of certain high-class woollens. Permanganate of potash is not largely used as a bleaching agent, but gives good results in a few applications.

So we have a rough sketch, necessarily limited in matter of detail in a brief and circumscribed review such as the present one, of the progress of the century in the subject of bleaching. Both the mechanical and the chemical sides of the art, as we have seen, have been highly perfected, and the modern practice of bleaching in treating huge quantities of cotton materials in all forms, and from the lowest to the highest qualities of fabrics, has attained the level of placing this country well ahead of all others in volume of production and in quality of work.

MERCERISING.

Towards the later half of the century under review a discovery of exceptional importance to the textile industries was realised in what is termed the operation of mercerising. It was John Mercer, a Lancashire calico-printer, who first noticed, as long ago as 1844, the action of concentrated solutions of caustic alkalies on the cotton fibre in changing it both physically and chemically. His observations, however, were limited to the effects of these solutions on cotton yarns and cloths, of imparting the qualities of increased affinity for colouring matters, greatly added tensile strength, and at the same time causing a linous contraction of from one-fifth to one-fourth. The more important discovery, though owing its inception to the prior and classical work of John Mercer, was made in 1889 by Mr. H. A. Lowe, a Manchester chemist, who had found that by mercerising cotton under tension with caustic alkalies the advantages of increased strength and accelerated affinity for colouring matters were gained, as by Mercer's original method, with the further valuable characteristics of preventing shrinkage and of imparting a permanent lustre, by the exertion of tension.

The value of this innovation was not, however, recognised until 1895, but from this date forward "mercerising" became quickly adopted, and established as a further achievement in adding to the appearance and the value of a large and varied class of cotton materials. The lustre of mercerised cotton is of a permanent character—that is, it is not effaced by washing, and, in certain conditions, it may equal that exhibited by materials made from silk. The many qualities acquired by cotton that has been subjected to mercerisation have placed it in a category to itself between ordinary cotton and silk, and though, at the time of the first appearance of mercerised cottons on the market, the new material was lauded by the producers as the successor to silk, and feared by the silk manufacturers as a competitor, neither the prophecy nor the fear has been realised. Its special recommendations quickly found mercerised cotton innumerable particular applications in the form of yarns and piece goods, along many new lines apart from those held by natural silk.

At the present time the process is so widely applied to the treatment of cottons as to form, in some instances, a self-industry and is, furthermore, associated as a branch of most dyeing and bleaching establishments with any pretensions to importance. Mercerised cottons assume such varied forms as sewing cottons, embroidery yarns, knitted goods, hosiery, cravat fabrics, beautiful poplins, exquisite zephyrs, silk-like sateens, pleasing brocades, and a host of other styles of fabrics and creations for the consumption of the home market and all the markets of the world.

The accomplishments that have been rendered possible by the process of mercerising in so firmly establishing a new branch of activity in the textile trade rank as a further mark of progress during the century. As in other subjects, the technical part of the process of mercerising as well as the theoretical and chemical considerations connected with it are to be found treated in the publications of the House of Griffin, notably "A Manual of Dyeing."

Dyeing and Calico Printing.

The earliest improvements of the century under review were in the employment of mineral colours developed on the fibre—*i.e.*, iron buff, Prussian blue, antimony orange, manganese bronze, and the yellow and orange chromates of lead. Then, in 1856, Perkin introduced the first of the coal-tar colours, which was the beginning of a new epoch in dyeing and calico printing. Progress is recorded in the standard works published by Messrs. Griffin, and in a "Dictionary of Dyes, Mordants, and other Compounds used in Dyeing and Calico Printing," by Rawson, Gardner, and Laycock, the advance upon early days is clearly marked, and reference is made to almost every substance of interest to dyers, with concise directions for their commercial valuation, and for the detection of adulterants. It was not until 1897 that artificial indigo was put upon the market by the Badische works, and afterwards other vat-dyes by numerous makers.

The limits of this article only allow mention of a few outstanding changes in practice resulting from discoveries which introduced new principles or necessitated adaptation. Often the book determined the practice and gave the needed impetus to fresh study, as was the case in the publication of "The Synthetic Dyestuffs, and the Intermediate Products from which they are Derived," by Drs. Cain and Thorpe. The publishers' confidence in issuing this work was sorely tested by the slow sale of the first edition, but its immense value was proved during the war, when the nation was rudely awakened to its need, and turned to Messrs. Griffin for help in this direction, as in so many others. Professor A. G. Green's "Analysis of Dyestuffs" was another of those almost classical volumes which proved especially welcome. Textile literature was none too abundant, and Griffin's had the good judgment to issue only such as was of the highest quality and met an immediate need.

We cannot overstate the importance of such a work as "The Principles and Practice of Textile Printing," by Dr. Knecht and J. B. Fothergill, which clearly and systematically set forth with much detail and excellent illustrations the most recent experience and working of a great industry. From the standpoint of book production, nothing finer has appeared in this country or abroad, a large selection of patterns having been specially printed and mounted in the text. With the same insight as to the practical needs of the textile worker, a most valuable contribution appeared from Griffin's press on the subject, "Engraving for Calico Printing," by Wm. Blackwood. It is a book of great merit from the hand of the one man capable of such a production, and stands alone as the only book on the subject.

Down through the ages the art of dyeing has been a domestic one, but for the past half-century or more a large business has been done in garment dyeing and cleaning, and Griffin's, ever watchful of current needs, so long ago as 1850, issued a book by J. M. Thomson, entitled "Practical Dyer's Assistant," and in later date Geo. H. Hurst's "Garment Dyeing," which had a very popular sale. The subject is now dealt with in masterly fashion by F. J. Farrell, all the dyes referred to being of non-German origin. This small but standard volume also includes the important subject of dry cleaning, wet cleaning, dry dyeing, and special methods for cleaning and dyeing hats, feathers, skin rugs, etc.

The "Manual of Dyeing," already referred to, is so complete and exhaustive that the subject of COLOURING MATTERS forms a large section. This chapter, however, would hardly be complete without a reference to another series of splendid volumes devoted specially to the subject of colours. Messrs. Griffin, with their wide outlook for national needs, did not fail to avail themselves of German thoroughness in this direction, and two admirable translations have proved most useful—" A Treatise on Colour Manufacture," by Zerr and Rubencamp, and " Tests for Coal-Tar Colours in Aniline Lakes," by Zerr—books of high scientific accuracy and great usefulness. The subject is also critically dealt with in a facinating manual—" Inks, their Composition and Manufacture," by C. A. Mitchell, in the section on examination of dyestuffs. To go further would be to trespass upon another chapter of this Volume. It is indeed difficult to know where to draw the line as Messrs. Griffin's thoroughness has led them to provide literature covering cognate subjects to the great textile industry. " Leather Trades' Chemistry," by S. R. Trotman, " Trades' Waste: Its Treatment and Utilisation," by W. Naylor, " Water Analysis for Technical Purposes," by H. B. Stocks, " Water Supply," " Pumping," " Coal Economy," " Smoke Abatement," " The Theory of Statistics," " The Co-operation of Science and Industry," and much more, all find place in their Catalogue, and are worthy of reference.

The growth of businesses has called for re-organisation, and the war has forced upon many the need of reconstruction, and here Messrs. Griffin are right up-to-date with a work entitled " Organisation as Applied to Industrial Problems," by Howard T. Wright.

In every direction of the Textile Industries Messrs. Griffin have proved themselves alert and eager, not only to provide books to keep pace with the gradual growth and scientific developments of the day, but they also have been of the greatest service in guiding the workers from rule-of-thumb practice to exact principles, whether operating through mechanical or chemical agency, thus producing greater perfection in their art. One of their forthcoming books may be mentioned as an example of this—viz., "Worsted Drawing and Spinning," by Geo. H. Davies. Here we have the practical experience of many years reduced to clear exposition under three main heads, machinery, wool, machinery and wool in combination, with the derivation of formulæ therefrom. As one who has himself benefited from the study of Griffin's publications, and holding in high admiration the splendid way in which they keep up to date succeeding new editions so that their books are always the last word on the subjects of which they treat, also having had opportunity of knowing how greatly these books are valued by students and practical workers, I venture to conclude this chapter with an expression of thanks to this Great Publishing House, and of congratulation to the present Chief, who, for the past quarter of a century, has so ably and successfully guided its affairs.

Alfred Brothers, F.R.A.S.,
Author of
"Photography Its History, Processes, Apparatus and Material."

Chapter XI.

GRIFFIN'S PUBLICATIONS (1820-1920)

IN

MEDICINE, SURGERY, HYGIENE, AND THE ALLIED SCIENCES.

By Medico, M.A., M.D., M.R.C.P.

Introduction—Early Publications in Chemistry and Medicine—A Medical Classic—Medical Pocket-Books—Hygiene and Public Health — Local Government Handbooks — Confidence of the Profession in Griffin's—Standard Medical Series—Change in the Personnel of Griffin's—Students' Text-Books—An Epoch-making Book—Nursing and Ambulance—Pioneer Publications—Household Medical Books—Conclusion.

Chapter XI.

GRIFFIN'S PUBLICATIONS (1820-1920)

IN

MEDICINE, SURGERY, HYGIENE, AND THE ALLIED SCIENCES.

INTRODUCTION.

THE story of book-publishing and bookselling during the one hundred years, from 1820 to 1920, included in this volume, even when limited to such prosaic subjects as medicine, surgery, hygiene, and the allied sciences, and still further limited to its association with one Publishing House, is yet so full of vital interest that the romantic side is lost sight of.

Charles Griffin & Co., Ltd., is one of the very few Publishing Houses with a consecutive history of one hundred years during which descendants of the founder have taken active part in the management; even here we find that the moving spirit during the last quarter of the century has been one outside the family circle.

In those far-away days of a hundred years ago, when "Griffin's" made their venture as "publishers," they were well established as booksellers and as general merchants, largely dealing in fine chemicals and chemical apparatus, their extensive premises in Nile Street, Glasgow, including not only a Lending Library, but a Chemical Museum. It is well to remember this, as chemistry and medicine are nearly akin, whilst surgery, hygiene, and sanitation are all related and first cousins to sanitary engineering, sewage treatment, bacteriology, and technical mycology.

The existing state of things in 1820 must also be borne in mind. "Trafalgar" and "Waterloo" were vivid memories, the locomotive and steamboat were yet in their infancy, whilst pack-horses and coaches with mails and merchandise trundled over bad roads, taking nearly a fortnight to travel from Edinburgh to London. Book distribution was no easy thing then, and it needed courage to attempt publication; no doubt the Griffin who was associated with Thomas Tegg, famed for his skill in "Book auctioneering and the 'Remainder' Trade," found it hard work to dispose of medical books, for the uniform Penny Post was not established until 1840, and doctors were unapproachable by 'phone.

EARLY PUBLICATIONS.

"Griffin's" certainly published books on chemistry from earliest days, and it is noteworthy that "Chemical Recreations," by John Joseph Griffin still survives.

Chemistry is so closely allied to medicine that I am bound to make reference to one or two of the early books published by "Griffin's," although naturally a whole chapter is given to the immensely important part their books have taken in industrial chemistry (see Chapter IX.). In 1820 they published "A Dictionary of Chemistry," by Andrew Ure, M.D., Professor in the Andersonian Institute, and the advertisement of it may be seen in the *Glasgow Courier* of that year.

"An Encyclopædia of Chemistry, with its applications to Mineralogy, Physiology, and the Arts," by Professor R. Dundas Thomson, M.D., F.R.S., was one of those masterpieces which are valuable for all time, and copies of this book are prized to-day by fortunate possessors. The author's claim in his Preface is interesting reading—" The time has arrived when Examining Boards must find it incumbent, particularly for the physician, to render practice in the chemical laboratory as imperative as attendance in the dissecting-room for the student of anatomy."

Another book of the utmost value to medical practitioners was " A Manual of Practical Chemistry," by A. Wynter Blyth, Public Analyst for the County of Devon. This had a great success, and has since expanded into two important volumes—" Foods: their Composition and Analysis " and " Poisons: their Effects and Detection," both of which are recognised standards to-day, having passed through many editions, and are the accepted works of reference in Courts of Law.

Mention must also be made of a learned and exhaustive treatise on " The Chemistry of Food and on Food Adulteration," by Dr. Scoffern, which appeared in Vol. VII. of " The Circle of the Sciences," published by Griffin's, which was very influential in directing Legislature to the adjustment of an important question.

To-day chemistry is a necessary part of the curriculum of medical students, and an up-to-date book is provided in " Elementary Practical Chemistry," by Dr. J. E. Myers and J. B. Firth, which has been adopted in many Colleges, and has quickly passed into a second edition.

Medical books in these early days had only a small place in Griffin's catalogue, though, in 1845, two small volumes by John Kitto entitled "Lost Senses: Deafness and Blindness," undoubtedly met with success as several editions were issued, and, in 1852, a large and notable work on "Zoology," by G. F. South, which cost £2,000 to produce, appears in their list. A little later (1856) Professor Richard Owen's useful little book on "Forms of the Skeleton and the Teeth" proved popular, and in 1857 Dr. Samuel Thompson's "Domestic Medicine and Household Surgery" was issued in parts, post octavo. This was the progenitor of the well-known book of the same title, which, after repeated revision by eminent physicians for succeeding editions, links up the past with the present, and to this reference will be made later.

AN EARLY MEDICAL CLASSIC.

The early training of Queen Victoria in science and the fine arts led her to extend sympathetic patronage to all such subjects as this chapter includes, and gradually, but surely, improvements took place in social conditions.

The Great Exhibition of 1851 in Hyde Park, though it failed to accomplish all that was hoped for, undoubtedly did much to enlighten leaders of thought and to encourage the onward movement for the betterment of the people. In all this "Griffin's" publications had a useful part, as this volume abundantly proves; but in 1854-56 the Russian War brought its devastation, and once again, as in the Great World War of 1914-18, it was found easier to wound than to heal. A most valuable contribution to Military Medicine by Surgeon General Longmore was issued by Griffin's entitled "The Sanitary Contrasts of the Crimean War," but, in 1858, they published "The Science and Practice of Medicine," by Dr. William

Aitken, F.R.S., a volume of 750 pages. This book was the outcome of an article upon the "Elementary Principles of Medicine," by Dr. Robert Williams, of St. Thomas's Hospital, London, which appeared in Griffin's great work "The Encyclopædia Metropolitana," and is one more evidence of its astonishing fecundity, for many books still enjoying large circulation had their origin here, It became at once the representative book of the science and practice of the day. Edition followed edition, and each was laboriously brought abreast of every recent advance in the healing art, so that for many years it was the recognised standard work. Of the seventh edition, in two volumes, royal octavo, over 2,300 pages and 200 engravings, Dr. J. Crichton Browne, F.R.S. said—"It is a classical work which does honour to British Medicine, and is a compendium of sound knowledge." Students of neurology and insanity turned to this book as the best in the language on their subject, whilst the article on Cholera was so replete with knowledge that it did much to stay the ravages of the disease in Eastern lands and to stamp it out in our own. The smaller book, "Outlines for Students," published in 1874, also met with great success. It is an interesting fact that Dr. Aitken stood godfather to Miss H. F. Griffin, who for some years has been a Director of Griffin's.

Limits of space only permit of reference to certain notable or typical books, sufficient to indicate that in this department of literature "Griffin's" have excelled and have proved of the greatest service to national life during the century to which this volume refers.

The Indian Mutiny followed hard upon the Crimean War, and the need of a large standing army continued for many years, so that the Army Medical School called for books; and, in 1875, to meet the requirements of the Field Medical Service, Griffin's produced "The Surgeon's Pocket-Book," written by Major J. H. Porter, which proved to be an invaluable guide, wholly adapted to the Public Medical Services, and was of exceptional value in the Afghan War. It passed through several editions. Even as late as the Boer War it was in great request, and during the recent World War every available copy was eagerly bought.

GRIFFIN'S MEDICAL POCKET-BOOK.

This book was the prototype of *Griffin's "Pocket" Medical Series of Reference Books*, which a few years later was announced, and eight volumes have since appeared. There was something very fresh and arrestive about this series, and the entire medical press gave it unstinted praise. Each volume was so perfectly designed to fill its special mission, and the contents were so admirably arranged that it captured the busy practitioner immediately, for he found it included the essentials of his subject systematically disposed for ready reference aided by excellent typography. The very features which commended the book for Military Service made it popular in home practice. Bound in morocco leather with gilt edges and rounded corners, it could not fail to please. The handy little volume was as dainty as a Church Service, and it is said that students have availed themselves of this similarity when attending service, but this is no doubt apochryphal. Several of the volumes have proved very successful. Dr. R. S. Aitchison's "Medical Handbook" has passed through four large editions, and a fifth has just been issued, thoroughly revised and reset. Dr. W. A. Brend's "Medical Jurisprudence and Toxicology" has found similar acceptance, and Dr. Gilbert E. Brooke's "Tropical Practice" contains practically everything required by a medical practitioner in the Tropics. This, too, has been almost rewritten for the new edition just published, whilst Caird and Cathcart's "Surgical Handbook" may be termed, without exaggeration, a CLASSIC, for it is as well known as any book handled by practitioners, students, house-surgeons, and dressers. It may be said of the entire series that the scientific spirit and standard is maintained throughout.

One other of the "Pocket-Book Series" I must mention —" A Handbook of Hygiene," by Colonel Davies, assisted, in later editions, by Brevet-Colonel C. H. Melville. Coming from the skilled hand of the Professor of Hygiene at the Royal Army Medical College, its authority was at once allowed, and the subject matter was so excellently compressed that, without any loss of accuracy, the Field Medical Officer had at hand all that was essential, splendidly arranged for easy reference. The book contained much more than was to be found in portly volumes of large type, and a critical and appreciative review in the *Lancet* concluded with the pronouncement, "We know of no better work."

Hygiene and Public Health.

I refer to this volume of the series last in order to draw attention to the very important part Griffin's have taken in this subject of Hygiene and Public Health. It is difficult to estimate the immense value of their service to the community through the fine lead they took in this matter. Half a century ago they produced Blyth's "Dictionary of Hygiene and Public Health," a comprehensive and erudite work based upon the great French work of Professor Tardieu. It comprised Sanitary Chemistry, Engineering, and Legislation (including the Public Health Act); Epidemic and Epizootic Diseases; Military, Naval, Public, Private, and School Hygiene. It was a work of extreme value and far-reaching influence, for it brought about much-needed reforms, and pointed the way to sanitary improvements on the principle that prevention is better than cure.

For a quarter of a century the influence of Blyth's "Hygiene" was operative, and by that time, in the sphere of Public Health, a new England existed; and Griffin's, ever alert to the progress of the times, introduced an entirely new work, "Practical Sanitation: a Handbook for Sanitary Inspectors and others interested in Sanitation," by Dr. George Reid, Medical Officer of Health, Staffordshire County Council. This book, like so many issued by Griffin's, was a *pioneer* work, but the time was ripe for it and it leapt from success to success, and by sheer merit of contents and of publishing has retained its place in the front rank, so that the twentieth edition is as strong a favourite as the first.

As a contrast to this, so far as success was concerned, let me here refer to another pioneer book, "The Hygienic Prevention of Consumption," by Dr. J. Edward Squire, which Griffin's published before the campaign for the prevention of tuberculosis was started in this country. In fact, this book laid the foundation for much investigation and research as to the means for preventing the spread of this disease in communities, and was largely instrumental in bringing about improved legislation for dealing with it in all its aspects. The sale was limited, but by its publication Griffin's secured that valuable asset of being pioneers in what has since proved to be a system of the utmost value to the community.

LOCAL GOVERNMENT HANDBOOKS.

Sanitary Authorities and their Officials have learnt to rely upon Griffin's for help in the wide range of subjects which call for their attention and supervision, and it is astonishing to find how splendidly Griffin's have provided for their needs by a great range of Local Government Handbooks in which the services of the Medical man, the Chemist, the Analyst, the Bacteriologist, and the Engineer have all been requisitioned—the sewage problem, river pollution, removal of putrescibility, disinfection, smoke abatement, water analysis, the examination of flesh foods by chemical, microscopical, and bacteriological methods, modern destructor practice, dairy farming, and milk supply, etc. It is difficult to draw the line in regard to the allied sciences, and, immensely important as they are, the space at my disposal will not allow of my referring to the magnificent library of books which Griffin's have placed within reach of those needing to know the last authoritative word upon their subject. It is due to them that I should make this passing reference, as, in my opinion, they have laid the whole community under a debt of obligation to them.

PROFESSIONAL CONFIDENCE.

From the foregoing it will be seen that Griffin's possessed the requisite self-confidence to produce and publish great works, and also the knowledge and skill to give to smaller books the needed breadth of circulation to make their issue worth while. It is natural, therefore, to find eminent physicians entrusting to them their manuscripts, and gladly availing themselves of their wide experience and reputation as publishers. It is interesting also to note that quite a number who were comparatively unknown when their books were first published have since risen to more than ordinary eminence, and in not a few instances have received the honour of knighthood. Many will remember the excitement caused over thirty years ago by Griffin's publication of Professor W. Stirling's English edition of Professor Landois's " Text-Book of Human Physiology." This was not merely a literal translation, but a masterpiece of English, and represented all that was best in this vast and far-reaching science. It was a mine of information, while its four hundred illustrations added greatly to its value, and placed the work far above any existing text-book. It took the Medical Schools by storm, and became popularly known as " Landois and Stirling." Notwithstanding its high price it sold by thousands, and passed through many large editions, holding its place for a generation; and it will always be regarded as one of the best text-books on the subject. When Professor Stirling was unable to give time to its revision the work was undertaken in America, where it had become a great favourite.

GRIFFIN'S STANDARD MEDICAL SERIES.

The publication of " Landois and Stirling " ushered in a period of great activity on the medical side of Griffin's business. A succession of authoritative works, large and small, was issued by them and met with great acceptance, so much so that it is difficult to determine which books to mention in this brief *résumé*. In 1886 a scholarly work appeared—viz., " Diseases of the Skin "—by Professor T. M'Call Anderson, of Glasgow University, who subsequently received the honour of knighthood. The *British Medical Journal* pronounced it beyond doubt the most important work on skin diseases which had appeared in England for many years. A second edition was called for, which the author thoroughly revised and enlarged.

Another work which came from the hand of a far-famed teacher was " Human Anatomy," by Professor Alexander Macalister, of Cambridge University. It was a great achievement to have obtained from so busy a man at the height of his popularity this magnificent contribution to scientific anatomy. It was eagerly sought by teachers of the subject, and did much to extend the influence of the beloved Professor. Griffin's tried their utmost to coax him to revise the work for a second edition, but his records were so voluminous that he was unable to reduce them to a sequence for publication. *The Quarterly Journal of Anatomy and Physiology*, published by Griffin's for a quarter of a century, occupied much of Professor Macalister's time, as, subsequently to the death of Sir William Turner, he became largely responsible for its conduct.

" Griffin's " wide outlook on the needs of the profession is evident from the great diversity of subjects dealt with during this period. Griffin's Standard Medical Series, issued in library style, many of them profusely illustrated, played no small part in lifting their name as publishers to the great eminence it attained, and which has since mounted in certain directions to that of pre-eminence.

"A Treatise on Gout," by Sir Dyce Duckworth, Lecturer at St. Bartholomew's Hospital, bore the stamp of authority, and gave to practitioners an immense amount of information in a thoroughly practical and well-reasoned manner. This was followed shortly afterwards by an equally important work, "Rheumatism and Rheumatoid Arthritis," by Dr. Archibald E. Garrod, which won great praise from the medical journals. Dr. Garrod has since been knighted, and recently succeeded Sir Wm. Osler at Oxford University.

Just about this date appeared in this series "A Text-Book of Mental Diseases," by W. Bevan Lewis, which the *Journal of Mental Science* spoke of as "the best book in English of its kind." It at once took front rank, and, passing into a second edition, was thoroughly revised and enlarged. This was the forerunner of several important works relating to the brain, nervous system, and legal medicine. Dr. Alex. Hill, then Master of Downing College, Cambridge, gave an excellent English version of Professor Obersteiner's invaluable text-book, "The Central Nervous Organs," which was recognised as the fullest and most accurate exposition of the subject. That bold and skilful neurological surgeon, Sir Victor Horsley, F.R.S., committed to Griffin's his manuscript, "The Structure and Functions of the Brain and Spinal Cord," which embodied his latest researches and conclusions; and he also allowed to be announced "A Systematic Work on Brain Surgery," but, unfortunately, the vehemence of his life carried him into such a multiplicity of professional duties and social causes, until his death in 1916, as consulting surgeon to the British forces in Mesopotamia, that the promised manuscript was never delivered.

Sir VICTOR HORSLEY, LL.D., D.C.L., F.R.S.,
Author of
"The Structure and Functions of the Brain and Spinal Cord."

One of the best text-books on forensic medicine and toxicology ever written came from the hand of Professor J. Dixon Mann, and again it is Griffin's the profession have to thank for it. To this work the Swiney prize was awarded. It has passed through many editions, and, since the death of Dr. Mann, the revision has been entrusted to Dr. W. A. Brend, whose work in connection with medical jurisprudence is so well known.

Here let me mention, although it appears later, a most useful and interesting work by Dr. Charles A. Mercier on "Lunatic Asylums: their Organisation and Management." The subject was treated with that logical arrangement and clear precise expression which marked his writings, and is admittedly the best of those which deal with the practical aspects of his life's work.

A book which does credit to British Scientific Medicine must here be referred to, "The Diagnosis of Diseases of the Heart and Thoracic Aorta," by Dr. A. E. Sansom. This book was aptly described as a treasure-house of knowledge, and was warmly commended to clinical workers. The following year another highly original work was published—viz., "The Diseases of Childhood" (medical), by Dr. H. Bryan Donkin, who has since been knighted. There was a great charm about this book, and it was evident that the author relied upon his own large experience. Practical and full of vigour, it won a high place in the esteem of the profession. Unfortunately the companion book on the surgical side of the subject never appeared.

Change in the Personnel of Griffin's.

This seems an appropriate place to refer to an important change in the personnel of Griffin's, necessitated by the death of members of the family, which readers of Chapter I. will have noted. This occurred in the year 1894 when this Standard Medical Series was well on the way of publication, and a quarter of the century had yet to run. The question has often been asked during these latter years. "Who is the driving power of Griffin's ?" and this in itself is a revelation of character, for Francis J. Blight is an unobtrusive and unpretentious man whose personality has impressed itself upon the business through years of concentrated effort and careful adaptation. When Griffin's sought his co-operation he had had eight years' experience of Medical Publishing with J. & A. Churchill, and was held in much repute as a microscopical draughtsman amongst eminent physicians, such as Sir James Paget, Sir William Gull, Dr. Tilbury Fox, Dr. A. E. Sansom, Professor W. S. Greenfield, and many others. When, a few years ago, he was elected F.R.S.E., the medical press joined in the expressions of congratulation. Following upon this accession to Griffins we find the most active period in the publication of works included in this chapter, which justifies this reference. Such notable books as the following may be mentioned :—"Clinical Medicine," by Dr. Judson Bury ; "Asylum Management," by Dr. Charles Mercier ; "Fibroid Phthisis," by Sir Andrew Clark ; "Diseases of the Heart," by Dr. A. E. Sansom ; "Atlas of Urinary Sediments," by Professors Rieder and Delépine ; "Pernicious Anæmia," by Dr. William Hunter ; "Diseases of the Organs of Respiration," by Dr. Samuel West ; "Applied Anatomy," by Dr. Edward H. Taylor, and many more which might be named, as well as new editions of older books which were practically new books.

GRIFFIN'S STANDARD MEDICAL SERIES (continued).

The high reputation of this important series was more than maintained by the sterling contribution to medical literature which followed. Dr. Judson Bury's Manual of "Clinical Medicine" was at once given a foremost place as a guide in clinical work, as, by its publication. practitioners were helped to utilise at the bedside the most recent researches of the Physiologist, the Chemist, and the Bacteriologist. It worthily stood beside its predecessor—viz., Dr. Garrod's translation of Professor von Jaksch's "Clinical Diagnosis," now in its fifth English edition. It has since been revised and brought into line with latest practice, with the help of Dr. A. Ramsbottom, and the current edition contains chapters on skin diseases, laryngoscopic examinations, and Rontgen rays in surgery.

The "beloved physician" of George Eliot, Sir Andrew Clark, M.D., LL.D., F.R.S., made notable contributions to medical literature, and it is an evidence of the great esteem in which "Griffin's" were held that his latest and most important piece of pathological and clinical work was entrusted to them for publication, "Fibroid Diseases of the Lung, including Fibroid Phthisis." This was the result of many years' thought, and had been written and rewritten and twice revised before his death. Drs. W. J. Hadley and Arnold Chaplin, of the London Hospital, gave valuable assistance in this revision.

It is fine testimony to the courage and enterprise of Griffin's that the one great work extant on Pernicious Anæmia appears in their list. In this remarkable book Dr. William Hunter, Examiner in Medicine at Glasgow University, deals in a highly instructive manner with the pathology, infective nature, symptoms, diagnosis, and treatment of this obscure disease. His investigations on the physiology of hæmolysis are most elaborate. There are many plates, some of which are exquisitely coloured.

Another fine work of supreme importance, which may justly be described as monumental, is "Diseases of the Organs of Respiration," by Professor Samuel West, of St. Bartholomew's Hospital, in two sumptuous volumes worthy in all respects of British Medicine, and copiously supplied with diagrams and illustrations. In its revised second edition it stands unrivalled as a standard work of reference.

One other typical work of this excellent series must have reference—viz., "Applied Anatomy: a Treatise for Students, House Surgeons, and for Operating Surgeons," by Edward H. Taylor, of Dublin. This book was recognised immediately as one of first-class importance, and the manner of its production met with unstinted praise. The cost and risk of such a publication must have been very great, as the original illustrations were numerous, a hundred and seventy-six being specially drawn for the book, many being in colours and all reproduced in excellent style, quite in keeping with the enterprise of "Griffin's," which has won the lasting thanks of their authors.

Closely associated with this Medical Series was Rieder's "Atlas of Urinary Sediments," with special reference to their clinical significance. It was translated from the German by Dr. Fred. C. Moore, and edited and annotated by Professor Sheridan Delépine, of Manchester. This met with unqualified praise, and, as an atlas, it could not be excelled, for the plates were beautifully drawn and reproduced in the highest style of art. The *Lancet* pronounced it "a success in every way," and the drawings "by far the best we have seen." Another work on the same important subject, "The Physiology and Pathology of the Urine," by J. Dixon Mann, is of inestimable value, and remains the accepted text-book on the subject.

STUDENTS' TEXT-BOOKS.

Griffin's have been quick to see the direction in which medical books would be of service, and have shown great powers of adaptation. The need for students' text-books and smaller manuals has been catered for with diligent care. Many of these are so excellent, and are so carefully brought up to date for each succeeding edition, that it would be difficult to name others of like popular esteem. For instance, "An Introduction to the Study of Midwifery, for the use of Young Practitioners, Students, and Midwives," by Professor Archibald Donald, of Manchester. No better book could be placed in the hands of the student, and for the eighth revised edition, just issued, the illustrations throughout have been specially drawn to show the most recent practice, which will undoubtedly increase the already great popularity of the book.

Another of this series which claims equal prominence is "Outlines of the Diseases of Women," by Sir John Phillips, which, from its essentially practical nature and succinct style, has found general acceptance. A valuable feature is the number of useful prescriptions which are models of what these should be.

Professor William Stirling's "Outlines of Practical Physiology" and the companion book, "Outlines of Practical Histology," received the highest encomiums from the medical journals, and enjoyed the confidence and recommendation of professors and lecturers. No text-books were more popular so long as Dr. Stirling kept them up to date, and they are still continually in request.

" The Physiologist's Note-Book : A Summary of the present State of Physiological Science for Students," by Dr. Alex. Hill, when Master of Downing College, Cambridge, gave concisely those essential points which are invaluable for a student to know. The typographical arrangement greatly facilitated easy reference. A thoroughly revised edition is in the press.

Sir W. H. Thompson, Sc.D., M.D., F.R.C.S., Examiner in Physiology, R.C.S.Eng., translated into English " The Work of the Digestive Glands," by Professor Pavlov, of Petrograd, and made most valuable additions. New and interesting facts were here presented to the student, and the current edition had been subjected to the most critical revision in the light of the latest research. Professor Thompson was scientific adviser to the Ministry of Food during the war, and went down on the "Leinster" when she was torpedoed.

" Diseases of the Digestive System," by Professor Robert Saundby, of Birmingham, in its second edition gave evidence of the sound judgment and strong personality of the writer. New ideas were carefully tested and only adopted after elaborate research, so that his book was found to be a most valuable guide and replete with the most recent information. Dr. Saundby also contributed " Medical Ethics," which it would be sheer folly for any student to pass by without careful perusal.

The art of feeding the sick stands in intimate relation to disease, and the student is fortunate to have at hand a manual of clinical dietetics, " Foods and Dietaries," by no less an authority than Sir R. W. Burnet, K.C.V.O., M.D., F.R.C.P., formerly Physician to the Royal Household. Griffin's issued this book at so small a price that a large circulation was ensured, and a fifth edition is now on sale.

"Flesh Foods: Their Chemical, Microscopical, and Bacteriological Examination," by C. A. Mitchell, B.A., F.I.C., has proved extremely useful, not only to medical men, but analysts and inspectors. It is an exhaustive consideration of a wide and difficult subject. Mr. Mitchell also provides an excellent translation of Dr. Oppenheimer's work, "Toxines and Anti-toxines," which deals very thoroughly with the theory of bacterial, animal, and vegetable toxines, such as tuberculin, ricin, cobra poison, etc.

From the same source came a veritable *multum in parvo*, entitled "Ferments and Their Actions," being a text-book on the chemistry and physics of fermentative changes.

These are books which students have found worth while keeping for reference when they have passed on to actual practice.

The subject of milk: its production and uses, dairy chemistry and analysis, dairy farming, the diseases of cattle, the hygiene and control of supplies, is of wide-reaching interest, and Griffin's have issued some of the best books on the subject to be had in the English language.

The various phases of practice are mirrored in these books, and students and young practitioners have found a growing sense of certainty in practice as they have mastered their contents.

An Epoch-Marking Book.

The subject of Anæsthesia is in the highest degree important, and in surgical practice it is paramount. Fifty years had passed since Simpson had introduced chloroform as an anæsthetic in British practice, when sulphuric ether was being used in America. Controversy continued to rage as to their comparative merits, when Griffin's work "Anæsthetics and their Administration: A Manual for Medical and Dental Practitioners and Students," by Frederick W. Hewitt, of Charing Cross Hospital, was published. In England the death-rate from chloroform had been serious, and Dr. Hewitt, who was a well-recognised authority, described in his book the more important anæsthetics, the operations each was specially adapted for, and the methods of administration. He lent the weight of his authority to *ether*, and claimed that every practitioner should have a working knowledge of the administration of anæsthetics, and some should specialise, as this was a branch of medicine which justified separate existence. The reading of this book for "review" purposes brought rich reward, for the subject was dealt with in a thoroughly practical manner, and its publication went far to establish Dr. Hewitt's fame. It was no surprise when, later, the honour of knighthood was conferred upon him, as his book was rightly described as epoch-marking, the beginning of a new age of deeper and surer knowledge of this fascinating subject. Griffin's deservedly received a full share of praise for their production of this standard work on a very important subject.

NURSING AND AMBULANCE.

The light from Florence Nightingale's lamp falls softly on the Nursing Profession of to-day, throwing into painful relief the "Sarah Gamps" of the mid-distance. Ordinary sick-nursing has developed into a great profession, having many special branches, and the training necessary for qualification is long and arduous. Bodily strength, as well as mental power and nerve, together with sympathy and refinement are pre-requisites to success, and the hospital training is very exacting. Queen Victoria's Jubilee Institute for Nurses proved of great service in raising the profession to its present high standing, and Griffin's have had no small share in this advance by the publication of valuable handbooks. Fifty years ago they issued "A Manual of Instruction for Attendants on Sick and Wounded in War," by Staff Assistant-Surgeon A. Moffitt, which proved of great usefulness in the Franco-German War, and continued in popular esteem. This success was, however, quite eclipsed by the publication of Dr. Laurence Humphry's "Manual of Nursing, Medical and Surgical." This can only be described as a triumph of publishing, for so cleverly was it introduced to the profession and boldly put upon the market that its fame became universal, and, notwithstanding the publication of other useful manuals, Dr. Humphry's has never for one moment wavered in popular esteem. It is now proverbial amongst nurses, "When in doubt look in Humphry's." Only a few months ago, writing to Messrs. Griffin from Mullion, Cornwall, whither he had gone to recuperate from war-strain, in his usual friendly way, Dr. Humphry expressed the hope of thoroughly revising the book for the next edition, but just as this proof is being passed for press the sad news of his death has come, and this Manual of Nursing becomes a monument of yet another Cambridge friend of the Publishers.

Another book coming under this heading is " A Manual of Ambulance," by J. Scott Riddell, M.V.O., C.M., etc., Examiner to the St. John's Ambulance Association. This has had a phenomenal success, and stands unrivalled amongst " First Aid " publications. A companion book for men at sea is " A Medical and Surgical Help for Shipmasters and Officers in the Merchant Navy," by W. Johnson Smith, F.R.C.S., of the Seamen's Hospital, Greenwich, revised by Dr. Arnold Chaplin, of the P. and O. Company. Both of these books have passed through many editions.

PIONEER PUBLICATIONS.

For the purpose of this review I have given sympathetic heed to the view-point of the Publishers, and it is evident that Griffin's, from the dawn of their century until now, have fearlessly faced the needs of the times and kept pace with its progress. Indeed, it would appear that, in some respects, they have shaped the future, for, as has been already noted, certain of their books have been pioneers into territory previously unexplored. " Hygienic Prevention of Consumption," " Anæsthetics and their Administration," and, another quite recently published, " The New Physiology," by J. Scott Haldane, M.D., F.R.S. This latest work is practically a revolution in physiology, for it challenges the whole accepted concepts. Dr. Haldane holds neither the mechanistic nor the vitalistic theory of biology, and in this remarkably thoughtful series of addresses he claims for biology an independent sphere or place of its own. In the issue of this book the pluck of the publisher is in keeping with the fearlessness of the author, since the subject is fiercely controversial.

Under this heading may also be noted Miss K. M. Curwen's very original and comprehensive handbook, "Simple Experimental Hygiene, Physiology, and Infant Management," since the writer was one of the pioneers of the movement for teaching hygiene in schools. A sympathetic review which appeared in the *British Medical Journal* admirably sets forth the value of this work:— "The scientific truths are taught with so great a charm and in so simple a manner that the interest of pupils and teachers will be secured, and the impressions made will be deep and lasting."

The suitability of women for the medical profession has long been decided in the affirmative, but it rested with Griffin's to focus thought upon it by the issue of a small, but serviceable, book "How to Become a Woman Doctor," to which Dr. W. J. Fenton contributed the Foreword.

Household Medical Books.

The Ministry of Health, with the Right Hon. Chris. Addison, M.D., as Controller, is only of recent appointment, and it seems but yesterday that the State awoke to its responsibilities and became foster-mother to the children of our land. Many years previously Griffin's had ministered to the needs of British homes by several most valuable publications conveying a vast amount of useful professional knowledge in language easily understood by the family at home or by the settler abroad.

Dr. Thomson's "Dictionary of Domestic Medicine and Household Surgery" was one such book, which first appeared more than sixty years ago, and has done an immense service. Its strictly scientific treatment is guaranteed by the fact that eminent practitioners took part in its revision from time to time, such as Dr. J. Charles Steele, of Guy's Hospital, Dr. George Reid, Medical Officer to the Staffordshire County Council, Sir James Cantlie, and Dr. Albert Westland. An earnest supporter of Christian Missions bequeathed several hundred copies of this book for the use of English Missionaries abroad, and the sales in England and the Colonies have been enormous, and are still maintained.

Another book of this description which is strictly professional to recommend, and which is certainly "the best of its kind," as the medical press has pronounced, is "The Wife and Mother," by Albert Westland, M.A., M.D., C.M. It is written with discretion and refinement, and conveys to the young wife in a most admirable manner just that information and guidance which a wise physician alone can give.

Dr. Arthur Leared's "The Causes and Treatment of Imperfect Digestion," first published in 1860, may also be mentioned, although long since out of print, but not until it had passed through seven large editions. It was published jointly with J. & A. Churchill.

Another work coming under this category, as it was written to be of service direct to the public, was "The Teeth: How to Preserve Them and Prevent their Decay," by S. H. Linn, M.D., D.D.S.

Public Health appears to have specially concerned Griffin's, and a thoroughly practical guide to the care of children in early life, by Dr. J. B. Hellier of Leeds, entitled "Infancy and Infant Rearing," has proved a mine of information to the Health Visitor, and they also publish Dr. W. A. Brend's very searching little book, " An Enquiry into the Statistics of Deaths from Violence and Unnatural Causes in the United Kingdom," with special reference to deaths from starvation, overlying of infants, burning, administration of anæsthetics, and poisoning.

CONCLUSION.

When I was invited to write this chapter I gladly complied, and the examination of my press files has proved most interesting, for it has shown me that opinions formed when first reading the books have, for the most part, been confirmed by experience. For the last thirty years I have found a pleasing recreation in reviewing for the press a very varied miscellany of books, medical, educational, literary, and foreign. Some hundreds of books have come under my scrutiny, Griffin's amongst the rest, and whilst I have not spared criticism, I have endeavoured to give an impartial and unbiassed opinion upon each. Although I should have been proud for my name to head this chapter, yet, for obvious reasons, it seems expedient for me to remain anonymous and trust to internal evidence to testify to the competence and experience of the writer.

If this chapter suggests the broad touch of the artist rather than the detail study of the botanist, I must plead that only thirty pages were at my disposal in which to convey an impression of the output and value of the publications on special subjects of one of the great Publishing Houses of Britain, so that a minute examination would have been tedious to the reader, and only a broad survey was possible.

Practical acquaintance with Griffin's books has convinced me that excellent judgment has been used in regard to the choice of subjects and of authors. Invariably I have found something of real and outstanding merit in publications bearing their imprint, and the most scrupulous care exercised in the reading of the proofs, for it was seldom errors in spelling or grammar could be found. In fact, their name inspired confidence in the reviewer with the pleasurable sense that his task was a light one. This chapter modestly concludes this Centenary Volume, yet the record is one Griffin's may well rejoice in, and goes to prove that their contribution to the literature of the subjects with which it deals has been so considerable that, even judged alone, and without consideration of the other vastly important sections of their catalogue, they are a Publishing House of which the Nation may well be proud, and that they stand in the front rank of medical publishers.

AN APPRECIATION

FROM

PROFESSOR JAMES PARK, F.G.S.,

Professor of Mining and Teacher of Applied Geology, and Dean of the Mining Faculty, Otago University, New Zealand, since 1901; Assistant Geologist to New Zealand Geological Department, 1878-89; Director Thames School of Mines, 1889-94; Chairman University Research Board, sometime President of New Zealand Institute of Mining Engineers.

THE Centenary of Charles Griffin & Company, Ltd., Publishers, is an event of national importance, and cannot be consummated without some message of appreciation from the Antipodes. Technical education is of imperial importance, and the publications of this House have taken a prominent part in the building of the Empire.

Resident as I have been for many years in the Dominion of New Zealand, and being well acquainted with the Commonwealth of Australia, and, moreover, having been privileged for more than thirty years to exercise some influence and supervision in University education, I am able to write with knowledge of the immense value out here of the Mining, Metallurgical, Engineering, and other Technical books which bear the imprint of Charles Griffin & Company, Ltd. It was the recognition of this which led me twenty years ago to turn to this House for the publication of my manuscripts, and I have never regretted doing so, as from the first they have extended to me ungrudgingly and without stint most helpful guidance. Very especially to the Chairman and Managing Director of the House, Mr. Francis J. Blight, F.R.S.E., I desire to express my thanks for personal attention, which has been of signal service to me, situated as I am so remote from the heart of the Empire. My visit to the homeland (for I am a native of Aberdeen) a few years ago gave me the opportunity of personal acquaintance with the House and its President, which remains a happy memory, and it is pleasant to record that wherever I went on the long journey, going and returning, visiting Universities and Colleges in India, in the Colonies, and in Great Britain itself, on all hands the name of Charles Griffin & Company, Ltd., was held in the highest possible esteem, and their text-books, manuals, and standard works of reference were given foremost place. Repeatedly the testimony was volunteered that their books were exercising the most powerful influence in the spread of technical education and in the development of the manifold industries which make Britain great. The high traditions which have gathered around the House during the earlier years of the century have been written in firmer hand in the history of the present. Famous as *pioneers* in the technology of pure and applied science, they have, during the last quarter of the century, so specialised in this direction that I think I am safe in saying none of the great publishing Houses is better known or held in higher esteem throughout the Commonwealth of Australia and the Dominion of New Zealand. Charles Griffin & Company, Ltd., have proved for many years one of the strong uniting forces of the Empire, and have done more than they can ever know in the promotion and development of the great over-seas Dominions, for which not only the Colonies but the nation is their debtor.

A TRIBUTE FROM
UNITED STATES OF AMERICA.

Philadelphia,
December, 1919.

My Dear Mr. Blight,

No doubt many notable events await the unveiling of the year, 1920, *but there is one event which is no secret, and is looked forward to with many good wishes by a large company in many parts of the world. I refer to the Centenary of Charles Griffin & Company. I learn that men of eminence in pure and applied science are now engaged in writing a volume worthy of the event, and I thought that a tribute from this side of the Atlantic might not be unwelcome.*

For many years past the publications of Charles Griffin & Company have been known and appreciated in the United States of America, but it has been specially during the last quarter of the century that our business relations have grown so intimate, and acquaintance has ripened into friendship.

J. B. Lippincott Co., of Philadelphia, must have handled hundreds of thousands of your books during these years, and it is safe to say that, from Philadelphia to San Francisco and from Cape Flattery to Florida, there is not a college of note that is not familiar with them, whilst individual workers in the great technical industries and in distant mining camps have found satisfaction in their use. Though *we have carried the majority of your books, yet we are aware that other American Houses have had a share, so that undoubtedly your influence must be felt from shore to shore.*

We offer our felicitations to your House upon the historic event of the completion of One Hundred Years of publishing, which, having regard to the technical subjects dealt with affecting as they do the vast industries of mankind, must be considered of world-wide interest. We trust the influence you wield may increase with the passing years, and that the generation succeeding may prove worthy of the high traditions they enter into. Our one deep regret is that your only son should have been snatched from you by the cruel war just when you had begun to lean upon his skilled help in the business. The little grandchild has much to live up to.

In conclusion, permit me to add a personal word of appreciation of the kind and generous welcome of your home which I have enjoyed in my annual visit to England during the last twenty-five years. "Blythe-hall," it might be named, for it is full of merriment and song, where culture and refinement place no restraint on freedom. I feel sure that a great measure of the success of the House of Charles Griffin & Company must be attributed to the personal interest that you have shown in the administration of the Company's affairs.

Yours very truly,

J. B. LIPPINCOTT CO.

H. G. RIDINGS,
Secretary.

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